

INSIDE: 1.5 billion reasons why Windows 10 will change everything

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APRIL 2015

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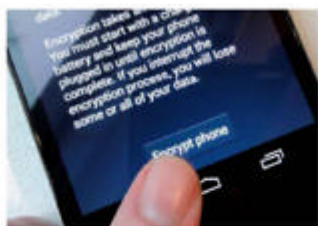
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video at
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com/winvid](http://go.pcworld.com/winvid)



Will Windows 10 change everything for Microsoft?

BY MELISSA RIOFRIO

YOU KNOW THAT moment in spy thrillers when the hero suddenly realizes the scope of the evil genius's nefarious plan? I had a moment like that at Mobile World Congress, when I sat down to talk with Greg Sullivan, Microsoft's Windows Phone Director of Public Relations. Not that anything he said was evil. He just made me stop short and realize why Windows 10 really could change everything for Microsoft.

The reason why is encapsulated in one number: 1.5 billion. That's how many Windows users exist worldwide, according to Sullivan. "We expect many will upgrade," Sullivan said. How many? "Very many," he repeated, with a dastardly smile.

Now's the time when the hero puts together all the clues. A lot of people will upgrade to Windows 10. Windows 10 will work across all devices, from phones to desktop PCs and everything in between.

Windows 10 will have universal apps that will work across all these devices. Let that all sink in.

What app gap?

Now think about the “app gap” that plagued lonely little Windows Phone. Once Windows Phone becomes part of this unified Windows 10 ecosystem, the app gap is gone. Poof. Obliterated from the face of the earth. In its place, a huge installed base of users will rise, ready and waiting for universal apps to work across all their devices. “You will suddenly have critical mass and a compelling reason for developers to make universal apps,” Sullivan explained.

Did I hear a cackle of glee?

It's a great plan. Universal apps will be able to scale their interface to the screen size of the device, as Microsoft demonstrated at a press conference. An Office app moved from a Windows Phone to a Surface tablet to the huge, 84-inch Surface hub display. The view redistributed itself neatly as it moved from device to device. Sometimes items shifted, but never so jarringly as to throw you off.

At the press conference, Microsoft's Stephen Elop (the former Nokia boss) also confirmed that phones that shipped with Windows 8.1 will be upgradable to Windows 10. Universal apps will have their own icon in the Windows Store, Sullivan said, and we'll hear more about them at the company's Build developer's conference, April 29 to May 1 in San Francisco.

Microsoft isn't the only evil genius plotting to rule the device world, of course. If Windows 10's universal apps gain any traction, a three-way fight with Apple and Google could develop. Now that would be fun to watch. Break out the popcorn, folks: This could be a very interesting year for the OS wars. 🔥



Once Windows Phone becomes part of this unified Windows 10 ecosystem, the app gap is gone. Poof.



Our best picks from Mobile World Congress 2015

BY FLORENCE ION AND JASON CROSS

EVERY MARCH, THE biggest hardware makers in the world converge in Barcelona, Spain, dragging their latest and greatest gadgets with them. The avalanche of new smartwatches, phones, and tablets stretches far and wide; just trying to see each device is difficult, much less touch them all.

But a small handful of gadgets inevitably stand out from the crowd. This year was no different. These are the best smartphones, watches, and gadgets we saw at Mobile World Congress 2015.

Samsung Galaxy S6

With the Galaxy S6 (go.pcworld.com/s6), it's like Samsung is giving us almost everything we ever asked for—even if they're taking away the removable battery and SD card slot in the process. It's got a gorgeous metal and glass body, a touch fingerprint sensor you don't have to swipe, an impressive new camera on the front and back, a super high-res AMOLED display, wireless charging that supports the two most popular standards, and a new payment technology that works with any credit card reader that does magnetic stripe swiping.



HTC One M9

The new One M9 (go.pcworld.com/m9) is all about subtle refinements. HTC took its winning design from the One M8 and made it better by tweaking button placement and grip. Then they improved the already-stellar audio, moved the 4-megapixel UltraPixel camera to the front, and put a high-res 20MP camera on back. Themes and dynamic app icons are highlights of the new Sense 7 interface.

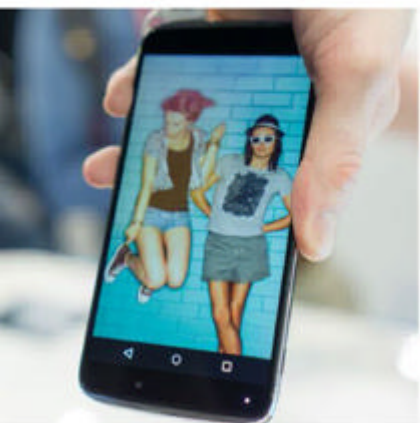
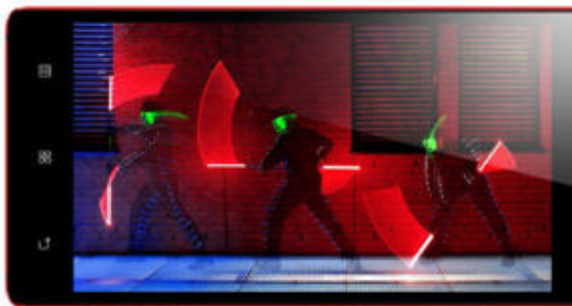


Huawei Watch

Huawei's Android Wear (go.pcworld.com/aw) watch does what other Android Wear watches do. So what makes it so special? Just look at it! This is the classiest watch in the Android Wear family. The simple sleek body is dominated by a round, bright, sharp OLED display. Available in stainless steel and gold, with a few bands to choose from, we can't wait for it to land this summer.

Lenovo Vibe Shot

The camera is so important to Lenovo's new Vibe Shot that they made the back of the phone look like a camera. It's an affordable phone with mid-tier specs, but sports a 16-megapixel camera with optical image stabilization, fast infrared autofocus, and a tri-color flash. There's a physical shutter button, and a pro/smart switch that enables features like white balance and ISO control for enthusiasts.



Alcatel OneTouch Idol 3

The two Idol 3 phones—a 4.7-inch model and a 5.5-inch version—share a similar design. They have a mic and speaker on both ends, so you can use it flipped upside down or rightside up. Even to make phone calls! As a bonus, the speakers enable stereo sound. The smaller phone should cost about \$200, while the larger one will go for \$250 when they launch in June. The specs aren't super high-end, but it's a lot of phone for the price, and the stereo JBL speakers and hold-it-whatever-way design might help the Idol gain notice.

LG Fxo

LG's Firefox OS phone is seriously cool looking. First off, it's see-through, like one of those first-generation Gameboy Color handhelds. It also has a very bright 4.7-inch IPS display and a 2,370 mAh battery pack, and the Home button is actually a gold-etched Firefox logo. You'll likely never see this one in the US, though: it's currently only available in Japan.



Samsung Galaxy E5

We really love Samsung's mid-range devices. They're stylish, cute, and compact, and they come with most of the same features as their flagship counterparts. It also just goes to show you that you don't need to spend a whopping \$600 to get a solid smartphone. The Galaxy E5 LTE version offers a bevy of selfie features, for instance, and it runs on a quad-core 1.2GHz processor.

HTC Vive

To quote the esteemed Mr. Keanu Reeves: Whoa. The surprise of the show, HTC's SteamVR-powered virtual reality headset made this virtual reality noob into a virtual reality believer (go.pcworld.com/vr). Unlike sedentary alternatives like Samsung's GearVR or the Oculus Rift, the HTC Vive was designed to let you wander around spaces up to 15 foot by 15 foot, with the help of a pair of base stations and wand-like controllers for each hand.



Alcatel Hero 2+

The Hero 2+ is Alcatel's first Cyanogen-powered phone, and we got a peek at the hardware. It's a 6-inch phablet with a 1080p display, 2GHz Mediatek processor, 2GB of RAM, and a 13-megapixel camera, as well as LTE support for AT&T and T-Mobile when it arrives in the US. It'll also come equipped with a detachable stylus, which Cyanogen's Steve Kondik (go.pcworld.com/sk) says you'll be able to use a la the Galaxy Note family. The phone we played with is still just a work in progress, however, and the finished product won't be revealed until later this spring.



You might know **Joshua**.
He loves video games, and he
owns enough to know they're not
all meant for kids. That's why he
reminds his friends (at least the
ones that have kids) that they all
have **big black letters on the box**
to help parents find the ones that
are best for their families.

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5 technologies Apple killed in the 12-inch MacBook

BY BRAD CHACOS

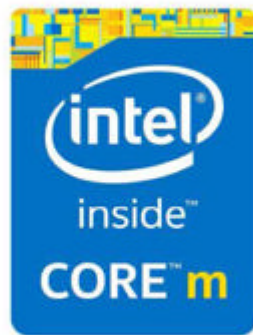
APPLE'S AUDACIOUS NEW 12-inch MacBook (go.pcworld.com/mb) is a beautiful example of an elegant, laser-focused laptop, from its ultra-svelte chassis to its fanless design and its cutting-edge layered batteries.

But such a ruthless focus on streamlining requires sacrifice—sacrifice personified by the 12-inch MacBook's spartan exterior, which sports only an audio jack and a single Type-C USB connector. These are the technologies that died so that the 12-inch MacBook may live.

Adiós Fans

Laptop fans help processors stay cool while they're performing tasks—but Intel's been on a quest to eradicate fans for years, and the 12-inch MacBook is the epitome of that.

The new MacBook uses a modestly clocked Core M “Broadwell” processor. While PC makers typically pair Core M with a fan, Apple's sticking to a 5-watt version that doesn't use a fan at all. Sure, it'll leave some performance on the table, but Core M already offers more oomph than Intel's Atom chips—and a fanless design married to an SSD means the 12-inch MacBook will be utterly silent.



While PC makers typically pair Core M with a fan, Apple's sticking to a 5-watt version that doesn't use a fan at all.

Bye-bye right-click

The 12-inch MacBook's new Force Touch touchpad declares war on the whole idea of the right-click.

Essentially, the laptop's trackpad packs four force sensors underneath its surface, which can register different degrees of pressure. That mindfulness let Apple introduce a new “Force Click” that occurs when you press down hard on the touchpad. OS X performs actions appropriate to the stimulus when you Force Click an item—Force Clicking a word in Safari, for example, opens a Wikipedia entry for it, while Force Clicking while rewinding a video file turns back the clock even faster.

Arrivederci video ports

The 12-inch MacBook's adoption of a single USB Type-C wonder cable kills off a slew of video ports once deemed critical on modern laptops. HDMI? VGA? DisplayPort? All gone, replaced by Type-C's ability to transfer video and audio signals using DisplayPort Alt Mode (go.pcworld.com/alt) over USB.

But the devices on the other end of the connection likely haven't adopted the cutting-edge USB Type-C standard yet, which means that

unless you're firmly ensconced in Apple's device ecosystem, you're going to need adapters—potentially a lot of them. Don't worry, Apple already has multiple adapters on sale.

Sayonara MagSafe power cords

USB Type-C can deliver up to 100W of power to charge your devices too, courtesy of the beefed-up USB 3.1 specification. Sayonara, MagSafe and hello, more adapters (go.pcworld.com/adapters).


Farewell Thunderbolt

Apple helped develop the ultra-fast Thunderbolt technology with Intel, so it's a bit of a shock to see the 12-inch MacBook forgo a Thunderbolt connection, severing the laptop's ties to that peripheral ecosystem. You won't find a Type-C to Thunderbolt adapter, either.

On the other hand, the USB 3.1 spec powering Type-C can deliver the same 10Gbps as Thunderbolt, and USB is much more widely adopted. If you absolutely need Thunderbolt compatibility, look towards the more traditional MacBooks; the 11- and 13-inch MacBook Airs were just updated to 20Gbps Thunderbolt 2.

In with the new...

That's a lot of technology to lose, but a lot of portability to gain. How does the MacBook's design stack up against Windows laptops on specs, flexibility, price, and more? Check out PCWorld's MacBook vs. PCs spec showdown in this issue to find out. If cutting-edge tech is your thing, the crazy Type-C USB is just one of many breakthroughs hitting the streets. 📶



Apple's single
USB Type-C
cable narrows
the peripheral
ecosystem to a
single port.



Up to 40% of businesses never recover after experiencing a major disaster. Do you have a plan to keep your business running if disaster strikes? For a free online tool that helps you develop an emergency plan, visit Ready.gov/business.

WHERE WILL DISASTER LEAVE YOUR BUSINESS?

Hands on: Google's new \$999 Chromebook Pixel

BY MELISSA RIOFRIO



TWO YEARS IS eons in tech time, and that's how long we've had to wait for a new Chromebook Pixel. Yes, this is a new version of the super-premium, high-priced flagship that debuted to oohs, ahhs, and whys in early 2013, when most Chromebooks were little cheap plastic things, and desktop applications dominated. Not everyone saw the potential of a high-priced browser box (go.pcworld.com/hmm).

Fast-forward two years: Chromebook sales are strong, and we're living more in the cloud than ever. As "Pixel 2" rumors (go.pcworld.com/p2) swirled in recent weeks, we honestly wondered how much

more this machine could have than it already does.

Now we have our answer. There's no sign of tablet-like functionality as rumored, but this new Pixel is once again touting a vision of greater online things to come. While we work on our full review, here's a closer look at the newest, fanciest Chromebook ever.

Mostly subtle changes on the outside

If you hefted the new Pixel, as I did, you might notice it's slightly lighter than before (3.3 pounds compared to 3.35 pounds) and even a scant millimeter thinner (15.3 compared to 16.2). Otherwise, it has the same sleek aluminum shell and gorgeous high-resolution display as the original, and its other outward changes are mostly subtle. Perhaps that's why Google chose, confusingly, not to give this new generation of its flagship a serial number 2.

The important changes are under the hood, and the biggest is the CPU. The first model's Intel Ivy Bridge chip had plenty of power but

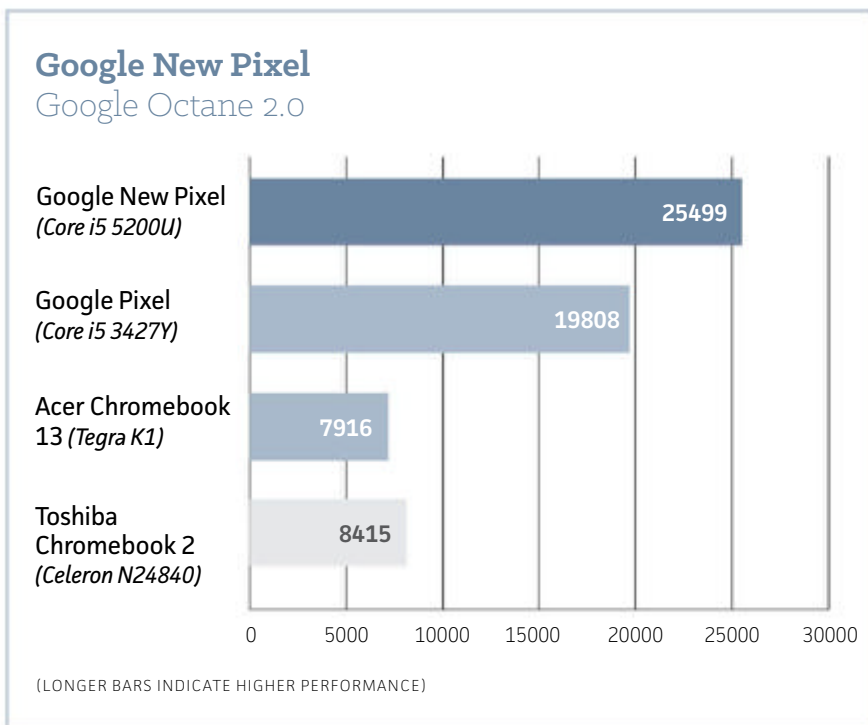


Compared side by side, the 2015 (left) and 2013 (right) Chromebook pixels look almost identical. The 2015 model is slightly lighter and thinner.

disappointing battery life—five hours by Google’s spec, but barely more than three hours in our review of the original Pixel. Two years later, Intel’s new Broadwell processors offer performance and battery life to spare. Here’s a peek at the performance we’re seeing so far.

As the chart above shows, the new Pixel is about 28 percent faster than its predecessor in Google’s own Octane 2 Javascript test, which measures latency when running browser-based applications. We asked Andrew Bowers, Google’s Director of Consumer Hardware, what kinds of apps would need all that power. “Gaming,” he replied, naming *Bastion* as an example. “Or having 50 tabs open, or driving multiple displays,” added Product Manager Adam Rodriguez.

Does that mean Chrome will be pushing for more game development? Rodriguez and Bowers exchanged looks before Bowers hedged, “not in





The keyboard on Google's new Chromebook has the same comfortable feel as the prior model's, and the top function keys are separated for greater convenience.

particular, but it definitely enables new use cases.” Uh-huh. We’re continuing to run other tests and will include the gory details in our full review, but so far, so fast for this Pixel’s new Broadwell CPU.

The new Pixel will have two CPU choices. We have the base unit, whose \$999 price—\$300 cheaper than the first-gen’s base model—includes a Core i5 CPU, 8GB of RAM, and a 32GB SSD. For \$1299, you can get the Pixel LS. The ‘LS’ stands, I kid you not, for “Ludicrous Speed.” A Core i7 CPU, 16GB of RAM, and a 64GB SSD await the lucky owners of this high-flying machine (Google did not provide LS review units.)

Google claims up to 12 hours of battery life on the new Pixel. That’s a big jump from before, and Google’s tweaked the Pixel’s behavior to help goose the number.

For instance, the backlight on the keyboard lights up only when it detects your hands hovering closely over the keyboard or trackpad. If your hands leave for more than 30 seconds, the backlight fades away, even when the Pixel is plugged in. The display also adjusts its brightness based on what’s shown onscreen. Of course, a huge battery helps: Google told me it was a 72-watt-hour power pack. We’ll tell you

how this monster fared in our tests when we finish our full review.

Here's the last big change: Two USB-C ports, on the left and right sides near the back, deliver both power and connectivity. You can plug in the included USB-C standard power adapter (\$60 to buy another) on either side, or one of Google's optional connectors for USB-C to HDMI (\$40), DisplayPort (\$40), or USB-A (adapter or cable, both \$13). The mini-DisplayPort, and dual USB 2.0 ports on the original model are gone; the new model has two USB 3.1 ports, an SD card slot, and an audio jack.

The other exterior changes are nice, if less noticeable. The display's piano-style hinge is a sturdier design. As a result there is noticeably less flex in the screen—always a good thing. A new trackpad (still etched glass) is bigger and more responsive, at least per Google, though I thought the old one worked fine.

The mini-DisplayPort, and dual USB 2.0 ports on the original model are gone; the new model has two USB 3.1 ports, an SD card slot, and an audio jack.



The new Chromebook Pixel has two USB 3.1 ports and an audio jack on its left side, plus a USB-C port for power and other connectivity.

The display changes slightly as well. It's still a 12.85-inch touchscreen with a stunning 2560x1700-pixel resolution and 400-nit brightness. For the new Pixel, Google also improved the color gamut. Most eyes may not notice the difference—to me, both the old and new screens are just plain gorgeous—but we'll tell you more after running some display tests.

So why no tablet functionality—say a hybrid form factor, or a 360-degree hinge? Bowers hedged again: “That’s one of a few factors we’re going to see more of.” But he moved away from tablets to touch, which both the old and new Pixel support. “We’re going to see touch become a more important factor.”

Think of the Pixel as a dream machine. It's not something everyone will be able to afford, or need. But it symbolizes what the Chrome OS ecosystem could be, and it's a necessary standard-bearer against the competition—high-end MacBooks and Windows systems like Dell's XPS 13. Most likely it'll land in the hands of developers and power users who want to push that ecosystem into the future. 🍷



15 new Steam Machines revealed

BY GORDON MAH UNG

AFTER A LONG delay, Valve's bid to replace your living room console with a true-blue gaming PC is finally taking shape. Valve and its partners revealed a whopping 15 new Steam Machines during GDC, and virtually every price point and internal component configuration was covered. (They're all small, though—these are supposed to fit in a home theater cabinet.) Valve's so serious that it even launched a new hardware section in the Steam store.

The Falcon Tiki pictured in Falcon's hand-painted "cloud" effect, which is done in a basecoat of silver metallic.



Watch the
video at
[go.pcworld.
com/steamvid](http://go.pcworld.com/steamvid)



If you're looking for impressions and video of the new Steam Machines, Gordon Mah Ung has you covered. Here, we'll take a peek at each and every new Steam Machine announced, from iBuyPower's \$450 SBX to crazy \$5000 rigs from Falcon Northwest and Origin. *PCWorld's* massive graphics card performance round-up (on page 78) can help you get up to speed with the various visual options offered.

iBuyPower SBX

iBuyPower's SBX (go.pcworld.com/sbx) isn't only the cheapest Steam Machine, starting at \$460. It's also one of the most console-esque in design—and check out that killer LED light bar wrapped around the system. It's full RGB and offers “multiple preset lighting patterns.”

Like consoles, and unlike many Steam Machines, the SBX can sit both vertically or horizontally. The base version packs an AMD Athlon X4 840 processor, a Radeon R7 250X graphics card with 1GB of onboard

memory, 4GB of RAM, and a 500GB hard drive.

A quick word of warning: Steam Machines aren't due to launch until November, which is eons away in technology time. Expect specific configurations for all these rigs to be slightly different at launch.

Alienware's Steam Machine

Alienware's Steam Machine (go.pcworld.com/asm) is available in several configurations, but its base model starts at \$480 and bears a striking resemblance to the shockingly good Windows-based Alpha console Alienware launched last year.

The base system includes a Core i3 processor, a custom 860M-like Nvidia GeForce GPU, 4GB of memory, and a 500GB hard drive. Beefier variants can be had for more cash, and all systems come with SteamOS and a bundled Steam Controller.

CyberPowerPC's Syber Steam Machines

CyberPowerPC's Syber division is diving into Steam Machines with full force, announcing no fewer than six separate models at GDC (go.pcworld.com/6).

The most affordable, the \$500 Syber Steam Machine A (go.pcworld.com/ssma), packs an Athlon X4 850 processor, a 2GB Radeon R9 270, 4GB of memory, and 500GB of storage. At the high end, the \$1,400 Syber Steam Machine packs a full-blown Core i7-4790K, a GeForce GTX 980 graphics card, 8GB of RAM, and a 1TB hard drive. It's hard to find components more capable than that, folks.

Syber will also craft you a Steam Machine from the hardware of your choice if the premade models don't cut it for you.



iBuyPower SBX



Alienware Steam Machine



CyberPowerPC Syber Steam Machine

Gigabyte Brix Pro

Gigabyte's \$600 Brix Pro (go.pcworld.com/gbp) is different from other Steam Machines in that, well, it doesn't come with SteamOS preinstalled. In fact, it doesn't come with memory or storage pre-installed either, according to its Steam store listing—like other Gigabyte Brix models, the Steam Machine is an itty-bitty DIY rig.

You will find an Intel Core i7-4770R processor, Intel's beefiest Iris Pro integrated graphics, and a PCI-E module that adds Bluetooth and 802.11ac Wi-Fi capabilities. The system supports a 2.5-inch SSD or traditional hard drive, as well as an mSATA SSD, and has two open 1600MHz SO-DIMM slots for RAM.



Gigabyte Brix Pro

Asus ROG GR8S

The potential Steam Machine Asus teased at Computex last year has finally become the Real Deal. The Asus GR8S (yes, "Great S," go.pcworld.com/gr8s) starts at \$700, but Asus isn't getting specific on specifications beyond saying it'll have Intel Core i5/i7 processors and Nvidia GeForce GTX 900-series graphics. Other notable features: Speedy 802.11ac Wi-Fi. Asus' ROG SupremeFX 5.1 HD audio, and 4K video output.

But the really notable thing about the ROG GR8S is its aggressive, angular design. Just look at the thing! It looks like an evil alien monolith.



Asus ROG GR8S

Digital Storm Eclipse

Digital Storm's Eclipse (go.pcworld.com/dse), unlike the ROG GR8S, doesn't start at \$700—it is \$700, with a single, set configuration.

While some of the diminutive Steam Machines pack mobile processors, the Eclipse sports a full-blown desktop chip and graphics card: Intel's G3220 and a Nvidia GTX 960, specifically. They're



Digital Storm Eclipse

joined by 8GB of RAM and a 1TB hard drive. Feel like upgrading? The rig packs extra room and adjustable brackets for DIY hardware updates down the line.

NextBox Steam Machines

NextBox (go.pcworld.com/nb) will offer three distinct Steam Machines. The first, costing \$800, packs a Core i3-4160, a GTX 750, 8GB of RAM, and a 1TB hard drive. A price-to-be-determined middle tier swaps out the GTX 750 for a more capable GTX 960.

The top-end \$1,400 configuration keeps the 8GB of memory but upgrades everything else, with a Core i5-4460, a GTX 970 graphics card, and a 512GB SSD.



NextBox Steam Machine

Maingear Drift

Maingear's \$850 and up Drift (go.pcworld.com/md) also brags about easy-peasy upgrade capabilities. This Steam Machine opts for some snazzy touches, like a unibody aluminum chassis and closed-loop liquid cooling design to chill your hardware without making a racket.

Specific configurations vary. Up to an Intel Core i7-4690K will be offered, along with graphics cards all the way up to the GTX 980 and Radeon R9 290X. The Drift tops out at 16GB of RAM, but offers abundant storage options, supporting up to two 1TB SSDs and a 6TB hard drive. Space like that is just begging to be filled during a Steam Sale.

Material.net Steam Machine

Like Digital Storm's Eclipse, Material.net's Steam Machine (go.pcworld.com/mn) is locked to a single, \$900 model. Inside you'll find an Intel Core i5-4440, an overclocked GTX 960 graphics card, and as-yet-undetermined storage and memory. That



Maingear Drift

Fractal Design case looks awfully darn slick, too.

Origin Omega

Origin takes the opposite approach. While its Omega Steam Machine (go.pcworld.com/om) starts at \$900, customization's the name of the game here, and Origin will offer variants that cost north of \$5,000—when you're hand-picking your own hardware, the sky's the limit.

Despite being a home theater-sized PC, the Omega can cram up to three GTX 980 GeForce cards into its chassis. (It looks like several cases will be offered, going by the Steam listing's images.) Processor support tops out with the Core i7-4770K, while up to 32GB of RAM and a whopping 14 terabytes of storage will be available. On the software side, Origin says it'll have a SteamOS/Windows dual-boot option available—but we'll have to wait and see how Microsoft reacts to that.

Webhallen S15-01

Back in the land of set configurations, you know what you get with the \$950 Webhallen S15-01 (go.pcworld.com/s15). This build features a Core i5-4460 processor with a H97 motherboard, a GTX 960 graphics card, 8GB of 1600MHz memory, and a 1TB SSD/HDD hybrid drive, all enclosed inside a purdy Bitfenix Pandora chassis.

Scan 3XS ST Steam Machines

Americans may not have heard of Scan's 3XS, but it's racked up awards and earned a "Royal Warrant of Appointment to Her Majesty the Queen as supplier of High Performance Personal Computers and IT Hardware" distinction in the



Material.net Steam Machine



Origin Omega



Webhallen S15-01

United Kingdom. Basically, these folks make PCs for the British Royal Court. Damn.

It'll be offering three ST-series Steam Machines (go.pcworld.com/3xs): A \$1,000 system with a Core i3 and a GTX 750, a \$1,160 system with a Core i5 paired with a GTX 960, and a \$1,300 machine with a Core i5 and a GTX 970. All come with 8GB of RAM and a 120GB SSD, with larger SSDs also available as upgrades.



Zotac Steam Machine

Zotac's itty-bitty \$1,000 Steam Machine (go.pcworld.com/zo) can fit in your hand, but the tiny box still surges with some big-time gaming power. (It's also one of the few Steam Machines that doesn't come in a black box.)

When it launches in November alongside the rest of the Steam Machines, it'll pack a sixth-gen Skylake Intel processor—a series of chips that aren't even out yet. That'll be joined by a mobile GTX 970M GPU, along with 8GB of RAM, a 1TB hard drive, and a speedy 64GB M.2 SSD. The memory and storage will be upgradeable, but the GPU (and likely the processor) will not. Zotac's rig has not one, but two Gigabit Ethernet ports and four HDMI outputs.



Zotac Steam Machine

Alternate Steam Machine

Your eyes aren't playing tricks on you: Alternate's Steam Machine (go.pcworld.com/alts) indeed uses the same chassis as Digital Storm's. Unlike the Eclipse, however, Alternate offers a variety of internal configurations. Four of them, in fact.

The "entry"-level \$1,100 rig marries a Core i3 processor and a GTX 750 Ti with a 500GB hybrid drive. That firepower



Alternate Steam Machine

seems astoundingly paltry for its \$1,100 price tag. Middle tiers offer a Core i5-4570 paired with either a GTX 960 or 970, while the “Ultra” configuration includes a Core i5-4670K, a GTX 980, and a 2TB hybrid drive.

Falcon Northwest Tiki

Finally, there’s a Steam Machine variant (go.pcworld.com/tiki) of Falcon Northwest’s iconic Tiki—one of the first rigs to kick off the mini-PC revolution. The highly configurable Tiki doesn’t come cheap, starting at \$2,000 with customization options available that can push the price to \$5,000.

But Falcon Northwest’s machine crams massive power in its tiny frame. It’s the only Steam Machine to offer Nvidia’s new Titan X super GPU as an option, and the Tiki’s processor—you can select anything up to a Core i7-4790K—is liquid cooled and available factory-overclocked. In a demo at GDC, that setup chewed through Unreal Tournament 2015 at 4K resolution and 60Hz.

Steam Controller and Steam Link

If you’re wondering how Valve’s crucial Steam Controller or dirt-cheap \$50 in-home streaming-only Steam Link box handle, you’ll want to read Hayden Dingman’s report (go.pcworld.com/ding) on these vital elements of the fledgling Steam universe.

As for the games you’ll actually be able to play on Steam Machines, *PCWorld’s* guide to killer Linux games (go.pcworld.com/linux) can help you fill up your hard drive with quality titles in no time. 🎮



Valve’s crucial Steam Controller

Google confirms it isn't selling the Nexus 5

BY DEREK WALTER

IF YOU WANT the Nexus 5, you won't find it in the new Google Store. Google confirmed it's done selling the last-generation flagship, a real downer for those who want a stock Android device that's a more practical size (and price) than the Nexus 6. While our Nexus 6 review (go.pcworld.com/6rv) found a lot to like in this gargantuan sized phone, it's definitely not for everyone.

Alternatives to Nexus 5

If mining the used phone market for a Nexus 5 or recently retired Google Play Edition device isn't for you, then let us offer some alternatives:

If it's the stock Android experience and timely updates you're after, the Moto X (go.pcworld.com/mx) is a solid option. With a 5.2 inch 1080p AMOLED screen it's a real looker, and the few add-ons Motorola includes are pretty helpful, like its Moto Assist features. Although like the Nexus 5, the camera is still subpar. On the upside, the dedicated Motorola update tracker site (go.pcworld.com/track)



The Nexus 5 was a practical choice for many Android users.

keeps you better informed about when your phone will see the latest flavor of Android.

Our favorite phone from last year was the HTC One M8 (go.pcworld.com/m8), which can probably be had for a decent price since it's about a year old. HTC takes updates seriously, pledging to bring them to its top-of-the-line phones within 90 days of release. It slipped a little this time due to some Lollipop bugs, but you could do far worse than going with HTC.

Also, don't forget there is a new HTC One M9 and Galaxy S6 making their way to your favorite carrier soon. They both ship with Android Lollipop, and Samsung has seriously dialed back its infamous TouchWiz to enable faster performance.

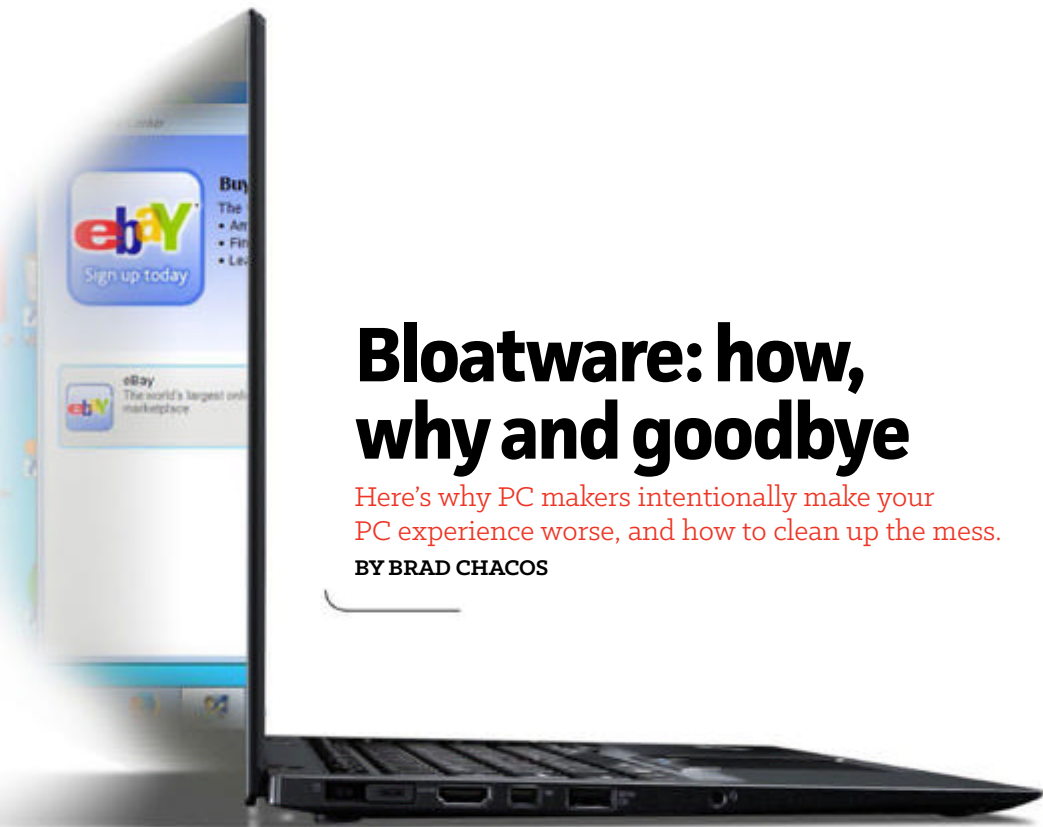
The impact on you: Unfortunately because the new Google Store doesn't offer as many stock Android devices as Google Play used to, you'll need to do some research for your next phone. However, a lot of Android users tend to be pretty savvy about Google's updates to Android, and such clamoring has pushed carriers and manufacturers to be more transparent about delivering timely updates. 📱



Our favorite phone from last year was the HTC One M8, which can probably be had for a decent price since it's about a year old.

Make smart purchases,
stay safe online.

CONSUMER WATCH



Bloatware: how, why and goodbye

Here's why PC makers intentionally make your PC experience worse, and how to clean up the mess.

BY BRAD CHACOS

BLOATWARE, CRAPWARE: No matter what you call it, the junk that PC makers dump onto new PCs is nothing short of a mess. The situation was in the spotlight recently when it was revealed that several Lenovo PCs were preloaded with “Superfish” adware (go.pcworld.com/superfish) that actively left users vulnerable to attack. The software compromised secure HTTPS web connections in a quest to inject ads on the sites you visit... and make Lenovo a few nickels.

There's no doubt about it: Even though the root vulnerability came from Superfish, Lenovo messed up. *Hard*. This shouldn't have happened (go.pcworld.com/no), period. But Lenovo didn't toss its users to the wolves out of malice—instead, the Superfish debacle is a natural extension of the entire bloatware epidemic.

Dolla dolla bills y'all

Bloatware exists because we're all cheap bastards, and rightfully so. Money's tight, and even the cheapest PCs are a major, multi-hundred dollar investment. But good news! Prices are plummeting in the wake of dirt-cheap Chromebooks and Microsoft's resulting counter-attack. The NPD group says that the average selling price of Windows computers fluctuated between just \$415 and \$430 in October 2014—10 percent lower than prices a year earlier, and a new low watermark for PCs.

While that sounds good on paper, deep down it's actually troubling news for the PC industry. Mainstream personal computers are a cut-throat business; prices have been racing to the bottom for years now.



Superfish injected ads in action on the Apple website.

PC vendors make little to no money on such slim margins, which is a core part of the reason HP is splitting off its PC division (again), Dell took itself private, and Sony and Samsung have bowed out of the PC industry to varying degrees. There's simply no real money to be made on dirt-cheap hardware. Enter bloatware.

PC makers don't really believe that short-lived antivirus trialware is the best security solution for you, or that adding browser toolbars will make your life easier, or that a "visual discovery tool" like Superfish truly adds to the user experience. The developers of bloatware pay hardware makers cold, hard cash to pump your PC full of this crap and get in front of your eyeballs. That extra revenue often makes all the difference for vendors between taking a bath on competitively priced PCs, or eking out a small profit. (There's a reason pricier premium laptops often contain far less bloatware than budget PCs.)

It's a symbiotic relationship for bloatware developers, PC makers, and everyday users. Bloatware effectively subsidizes PC prices. If it didn't, you'd pay more—perhaps much more—for your computer.

The developers of bloatware pay hardware makers cold, hard cash to pump your PC full of this crap and get in front of your eyeballs.

Beat it, bloatware

Even ignoring Superfish's security implications, the sea of junk consumes your PC's precious hardware resources and can significantly slow down boot times, as this since-removed graphic advertising (go.pcworld.com/graphic) Microsoft's Signature Edition PCs shows.

The easiest way to deal with bloatware is to sidestep it completely. Microsoft—which obviously wants to present Windows in the best possible light—offers bloatware-free "Signature Edition" versions of many popular PCs, from the \$200 HP Stream 13 to the jaw-dropping Dell XPS 13 and even more expensive models. Even better, Microsoft charges little or no premium for its clean computers; the biggest price gap we found between a Signature Edition PC and its crud-filled counterpart was \$30. You can check out the full lineup here: go.pcworld.com/lineup.

Microsoft puts its money where its mouth is, too: The company's Surface laptop-like tablets are similarly bloatware-free.

The Signature Edition lineup focuses on notebook and all-in-ones, however. If you want a proper bloatware-free desktop with a bit more firepower, you'll need to build your own machine and install Windows yourself. Don't worry! It's not as difficult (go.pcworld.com/build) as you may think.

Alternatively, boutique system builders like Digital Storm, AVA Direct, and Origin can build you a custom rig with nary a whiff of shovelware installed. Their PCs tend to be a bit pricier and focused on gaming or business-ready workstations, however.

Cleaning up the mess

All's not lost if you buy a standard bloatware-filled PC, however. Wiping run-of-the-mill crapware off your PC is fairly straightforward, assuming it doesn't sneak in deeper, more dangerous hooks like Superfish did. (Lenovo's Superfish appears to be a unique situation, however—at least for preloaded bloatware. PCWorld's guide to Superfish removal (go.pcworld.com/removal) can help you kill it with fire if you've recently purchased a new Lenovo PC.)

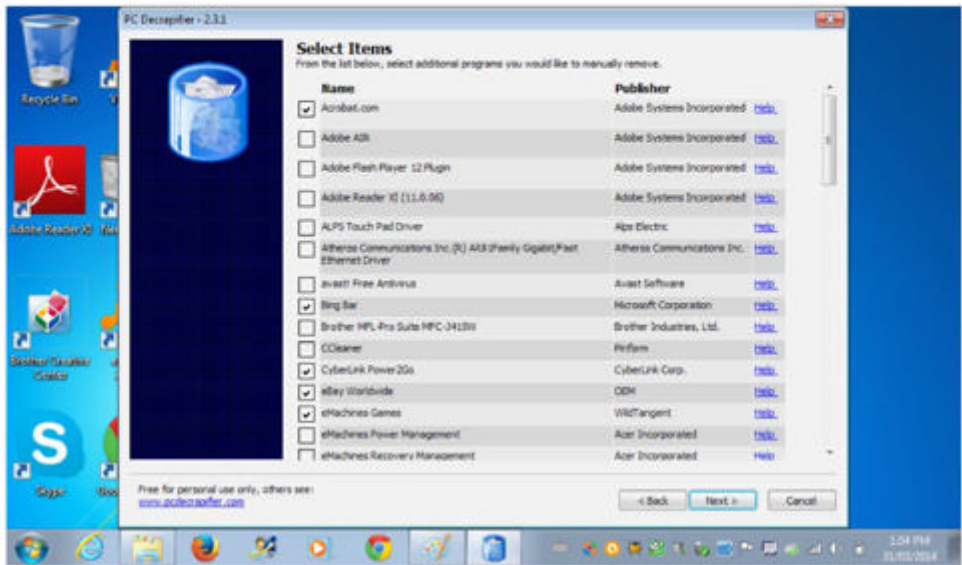
Deleting bloatware in the form of Windows Store apps couldn't be easier: Just right-click on its Tile, then select Uninstall. Boom! Done. Likewise, sifting through the list of software in the Control Panel's "Uninstall a Program" section (**Control Panel** > **Programs** > **Uninstall a program**) will let you see all and eliminate all the crapware that takes the



After 30 days without Signature



After 30 days with Signature



form of traditional desktop software.

Automated tools like PC Decrapifier (pcdecrapifier.com) can speed up the process. Should I Remove It (shouldiremoveit.com) does the same, while also providing recommendations about whether to remove specific programs. For more in-depth instructions, check out PCWorld's guide to blasting bloatware off your PC (go.pcworld.com/blast).

Remember to reactivate Windows Defender or install some security software if you remove trialware antivirus from your PC. You don't want to head into the wilds of the Web unprotected.

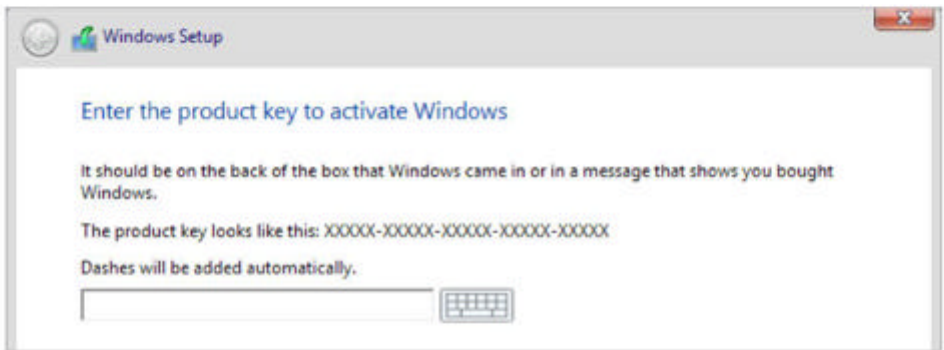
If manual labor isn't your thing, a clean installation of Windows can give you the proper like-new experience that Microsoft intended, though novice PC users probably shouldn't muck around with reinstalling their operating system.

But wait! You don't want to rely on Windows 8's Refresh and Reset feature or your PC maker's recovery images (*if* your PC maker even includes those). Sly system manufacturers have begun sneaking bloatware into their system images, meaning that if you reinstall

PC Decrapifier does exactly what the name says.

Windows with the provided tools, you'll also be reinstalling the preloaded crapware—pretty much the opposite of a fresh install.

To perform a truly clean install you'll need fresh Windows installation media and the product key for your PC's Windows license. PCWorld's guide to reinstalling Windows (go.pcworld.com/windows) like a pro can walk you through the entire process, step-by-step. You may need to download some hardware drivers again when you're done.



Phew! That was a lot of work, but now you should be staring at the pinnacle of computing: A new PC with a cleanly installed operating system. What now? It's time to start filling it with more useful software, of course. We've got your back here, too. Check out our guides to the 22 free programs your new PC needs (go.pcworld.com/22free) and 20 obscure, yet powerful free programs that ease your daily tasks (go.pcworld.com/20free) for a slew of suggestions.

Just be sure to mind those options while you're installing new software—you don't want to leave a rogue checkbox filled in and stuff your fresh PC with all-new bloatware! 🚫

The installation media for Windows 8 is free, but you'll still need a valid product key to install it.



The facts behind UEFI firmware on your PC

BY CHRIS HOFFMAN

EVEN IF YOU'RE rocking the most open of open-source operating systems, chances are your laptop isn't really that "free," betrayed by closed firmware binaries lurking deep within the hardware itself.

Modern UEFI firmware is a closed-source, proprietary blob of software baked into your PC's hardware. This binary blob includes remote management and monitoring features, which make it a potential security and privacy threat (go.pcworld.com/threat).

You might want to replace the UEFI firmware and get complete control over your PC's hardware with Coreboot, a free software BIOS alternative—but you can't in PCs with modern Intel processors, thanks to Intel's Boot Guard and the "Verified Boot" mode PC manufacturers choose.

Why Coreboot won't support your new laptop

Coreboot was originally known as LinuxBIOS. It's a Free Software Foundation-endorsed project working on replacing the proprietary UEFI firmware and BIOS found in typical computers. Coreboot is designed to be lightweight and only provide the necessary functions so the computer can initialize its hardware and boot an operating system. This isn't just some fringe free software project—all modern Chromebooks ship with Coreboot, and Google helps support it.

When someone recently asked whether Coreboot would support new Intel Broadwell ThinkPads on the mailing list, the response (go.pcworld.com/coreboot) was informative: "New thinkpad's can't be used anymore for coreboot. Especially the U and Y Intel CPU Series. They come with Intel Boot Guard and you are won't be able to boot anything which is unsigned and not approved by OEM. This means the OEM are fusing SHA256 public key hashes into the southbridge.

All modern

Chromebooks ship with Coreboot.



For more details take a look at Intel Boot Guard architecture. It could be also confirmed by Secunet AG and Google.”

Intel Boot Guard explained

Intel themselves have a quick explanation of Boot Guard in this document (go.pcworld.com/boot) about Haswell’s new platform features. In summary, Boot Guard is a hardware-based technology designed to prevent malware and other unauthorized software from replacing or tampering with the low-level UEFI firmware.

Boot Guard has two separate modes, according to Intel. Every single PC OEM we know of configures it to work in “Verified Boot” mode. The PC manufacturer fuses their public key into the hardware itself. If the UEFI firmware isn’t signed by the OEM—that is, created by the OEM—the computer will halt and refuse to boot. That’s why you can’t modify the UEFI firmware or change it to something else.

There’s also a second option: “Measured Boot” mode, where the hardware securely stores information about the boot process in a trusted platform module (TPM) or Intel Platform Trust Technology (PTT). The operating system could then examine this information, and—if there was a problem—present an error to the user.

As Purism recently discovered (go.pcworld.com/purism), laptop makers can choose to have their hardware boot without looking for a digital firmware signature at all. The fusing of the processors can be set by the motherboard manufacturer to simply bypass the check. Purism’s crowdfunded Librem 15 laptop will ship with a modern Intel CPU fused to run unsigned BIOS code.

Intel and Boot Guard don’t absolutely require hardware manufacturers to lock the computer to only using manufacturer-signed firmware, but every major PC maker does anyway.

It’s all a big conspiracy, right?

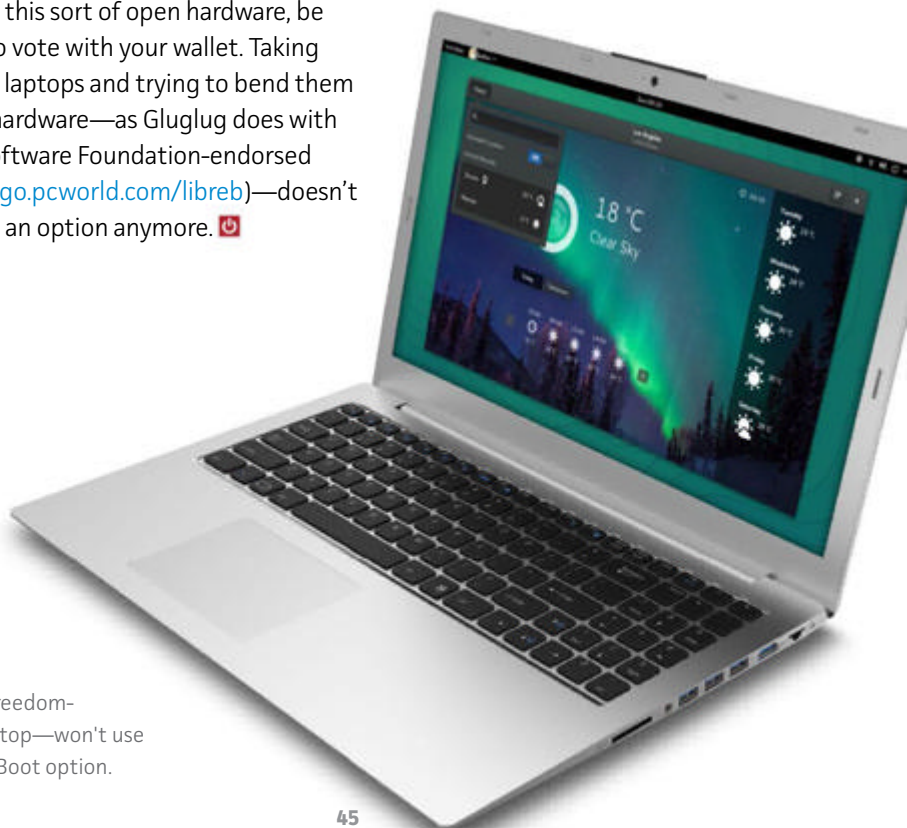
It can be tempting to see this as a big conspiracy. These big corporations—Intel and hardware manufacturers—are preventing us from running the software we want to run on our own computers, as if

we were using some underpowered, locked-down Surface RT instead of a powerful PC we're supposed to have control of.

And sure, that's true, but Boot Guard does help secure the UEFI firmware and protect against malware that infects the boot process. Intel and PC OEMs aren't out to crush free software and prevent open hardware. The truth is more mundane—Intel and hardware manufacturers prioritize tighter security for the masses over the proprietary firmware concerns of a few.

But, to their credit, Intel does allow PC manufacturers to configure the hardware in a different way. The real way to get that open hardware seems to be to build it from scratch and make the right decisions along the way, as Purism is trying to do.

If you want this sort of open hardware, be prepared to vote with your wallet. Taking existing PC laptops and trying to bend them into open hardware—as Gluglug does with the Free Software Foundation-endorsed Libreboot (go.pcworld.com/libreb)—doesn't seem to be an option anymore. 🔌



Librem 15

—Purism's freedom-obsessed laptop—won't use the Verified Boot option.

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analysis for passionate Android users
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Asus ZenBook UX305F: the best budget ultrabook

BY GORDON MAH UNG

ANALYSTS LIKE TO bemoan the PC industry's penchant for "racing to the bottom," but they always seem to forget the benefits of low-end competition: bargain prices for better hardware.

Asus' new ZenBook UX305F (go.pcworld.com/asusux305F) is proof that racing to the bottom doesn't have to end in a duffel bag of compromises and tears. In fact, the ZenBook UX305F is one those laptops that defies conventional wisdom on build quality, specs, and price.

Here's the big news up front: the ZenBook's decidedly budget price of \$699. For an ultrabook, that's a big deal because most "ultrabooks" at this price really aren't that ultra. They're clunky and chunky bricks that pack 10rpm hard drives that load Windows so slowly you can practically



Watch the
video at
[go.pcworld.
com/ux305Fvid](http://go.pcworld.com/ux305Fvid)



watch the pixels fill in one by one.

One look at the ZenBook tells you it's not a plus-sized laptop masquerading as an ultrabook either. There's no cheap plastic; it's an aluminum skin. Asus says the shell is constructed of .5mm thick aluminum, which makes it one of the thinner 13.3-laptops around. The Dell XPS 13 2015 measures at 18mm. The original ultrabook, Apple's MacBook Air 11 is 16.8mm. The Asus? 13mm.

Inside you won't find a Celeron, Pentium or similar low-rent Bay Trail-based Atom SoC, Asus instead taps Intel's low-wattage Core M 5Y10 CPU. That's a Broadwell chip, but the Core M is locked down to consume a third of the power of a Core i5 or Core i7 Broadwell.

This lets Asus actually build the ZenBook as a true fanless laptop, so it's utterly silent. The company says the ZenBook features "IceCool" design, using chromium copper alloys to keep the CPU and internals of the laptop from cooking. Perhaps true for the insides, but I did find the outside could get hot. After running an encoding test for an hour, I snapped thermal images of the back and front of the ZenBook and saw temps of

Despite its budget price, there's very little low rent about the ZenBook UX305 that I could find.



Asus ZenBook UX305F

PROS:

- 256 GB SSD
- 1920x1080 IPS screen with anti-reflective coating.

CONS:

- Core M can lag in performance

BOTTOM LINE:

Simply the best budget ultrabook around.

\$699

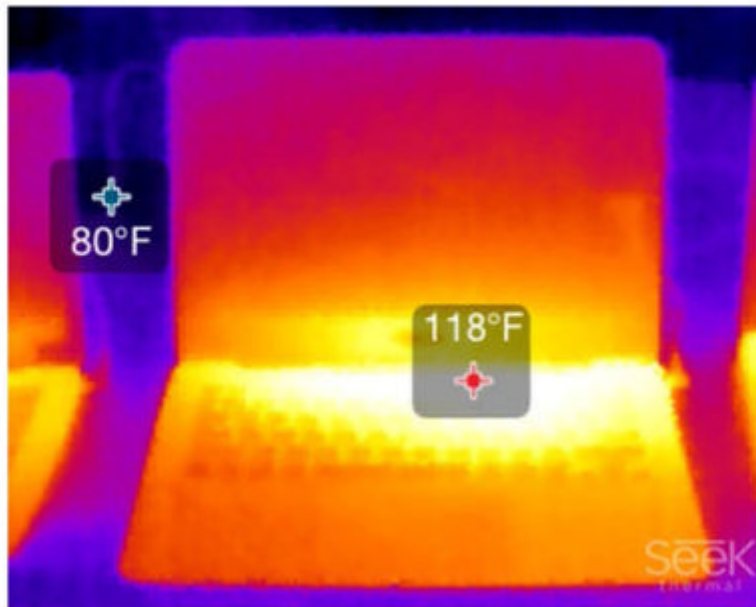


snapped thermal images of the back and front of the ZenBook and saw temps of 120 degrees and 118 degrees. A similar HP EliteBook that I'm reviewing, with its (admittedly slower) Core M chip, was almost 20 degrees cooler.

On the test bed

The ZenBook is the second Core M-equipped laptop I've seen. Ultraportable performance isn't as critical as it is for, say, a gaming desktop or workstation, but it's still worth measuring.

To do that, I first looked at how well Core M performed against Dell's XPS 13 2015 and a Lenovo ThinkPad X1 Carbon in PC Mark 8's test for work tasks. It's nothing to write home about and what I would expect. The test is designed to measure office drone tasks, and we can all agree that it plateaus pretty quickly once you get to a certain performance level. The upshot is that you really don't need an overclocked 8-core Core i7 to run Microsoft Word or human-level Excel tasks.



The fanless

ZenBook UX305F after a one hour encode gets almost too warm.

Asus ZenBook UX305

HandBrake Encode 0.9.9 (seconds)

**Asus Zenbook
UX305**
(Core M 5Y10)

9948

Lenovo X1
Carbon 2014
(Core i5 4300U)

9228

Dell XPS 13
2015 FHD
(Core i5 5200U)

8091

Dell XPS 13
2015 QHD+
(Core i5 5200U)

7592

0 2000 4000 6000 8000 10000

(SHORTER BARS INDICATE HIGHER PERFORMANCE)

The fanless Core M gives up pure CPU performance but not as much as you'd think.

I also ran our standard encoding tasks, where we take a 30GB MKV file and transcode it using HandBrake to a size and format friendly to an Android tablet. It's a heavy workload for a laptop, but not unheard of considering the capability of laptops.

While you don't need a big CPU in office tasks, you can see where the dual-core Core i5 chips, with their greater power consumption and higher clock speeds, have an advantage. With a third of the thermals to work with, the dual-core Core M 5Y10 just doesn't have the megahertz to keep up with the pack, but it's still respectable. I wouldn't let this be a deal-breaker unless CPU-intensive chores are job No. 1. If so, it's worth paying for a Core i7 part instead, but in general, most people won't notice much of a difference with a Core M.

Asus ZenBook UX305

3DMark Cloud Gate

Asus Zenbook UX305

(Core M 5Y10)

Lenovo X1

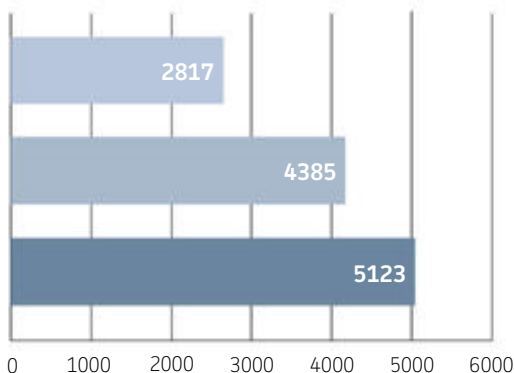
Carbon 2014

(Core i5 4300U)

Dell XPS 13

2015 FHD

(Core i5 5200U)



(LONGER BARS INDICATE HIGHER PERFORMANCE)

You do give up considerable graphics performance by going with the low wattage Core M Broadwell chip over the Core i5 Broadwell U part.

Core M lacks in graphics power, too

The Core M CPU is about low power and low thermals. That's better than Atom, Celeron or Pentium performance, but still far less than a full-tilt Core i5 chip using a CPU that consumes three times its power. When running our HandBrake encoding test and the 3DMark Cloud Gate graphics test, this becomes very apparent: You give up a lot of performance. Granted, the integrated graphics in an i5 won't let you play a graphically intense game at any reasonable frame rate, but the Core M's gaming chops take a definite backseat—about the equivalent of HD4000 graphics in an older Ivy Bridge CPU.

Decent battery life

Perhaps one of the most important metrics in a laptop is battery life. I ran MobileMark 2014 on the ZenBook and compared its numbers to

the Lenovo ThinkPad X1 Carbon and both Dell XPS 13 units.

MobileMark 2014 is a real-world rundown test, using off-the-shelf popular apps such as Office and Photoshop and replicating a typical work session. The test simulates a person pulling up an email and sitting there and actually reading the email for five minutes, for instance, rather than simulating a person typing like an automaton for eight hours straight.

With a 45-watt-hour battery and power-sipping Core M chip, the Zenbook lasted a healthy 638 minutes. The Dell XPS 13 2015, with a larger 52-watt-hour cell (but higher-res screen) came in lower, at 602 minutes. I had time to test the Dell's XPS 13 2015 with 4GB of RAM, a 128GB SSD and 1920x1080 screen. Priced at \$799, it's the most direct competitor to the ZenBook. Shedding the high-resolution panel and

Asus ZenBook UX305

MobileMark 2014 Battery Life (minutes)

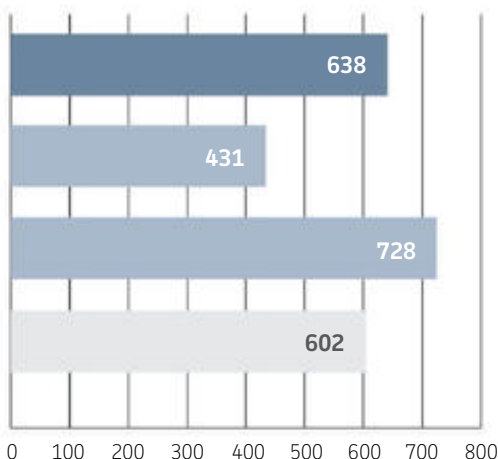
Asus Zenbook UX305

(Core M 5Y10)

Lenovo X1 Carbon 2014
(Core i5 4300U)

Dell XPS 13 2015 FHD
(Core i5 5200U)

Dell XPS 13 2015 QHD+
(Core i5 5200U)



(LONGER BARS INDICATE HIGHER PERFORMANCE)

The **ZenBook UX305F** and its Core M has admirable battery life of 10 hours. Only the 1080p version of the Dell XPS 13 2015 out runs it at 12 hours.

touch option allows the Dell XPS 13 to run at a healthy 602 minutes to 728 minutes.

The older ThinkPad X1 Carbon 2014, with a 46-watt-hour battery, did the worst at 431 minutes. I'm expecting to see the updated ThinkPad X1 Carbon soon. Perhaps the X1 Carbon can stage a comeback.

There's nothing budget about the specs

Moving back to the physical attributes of the ZenBook, I have to say I expected far more corners to be cut. For example, I expected the 13.3-inch screen to be an inferior TN panel. Instead, Asus uses a 1920x1080 resolution IPS screen and an anti-reflective coating. They also make a version with a 3200x1800 panel that offers optional touch. The 1920x1080 display is competent. I didn't see any terrible color banding, and although Asus rates it at 300 nits in brightness, it pegged our meter at 340. I did see noticeable light leakage from the backlighting when cranked up to maximum in a dark room. But at normal brightness levels for a darkened room, it's not atrocious.

In storage, I also expected a budget move, like a hybrid drive or a leftover mSATA drive. Asus actually surprised me with a 256GB M.2 SATA SSD. Let me say that again: a 256GB SSD. If you think about it, that's far more than what you're getting anywhere else. Period.

The keyboard isn't bad either

I even found the keyboard to be pretty good. One of my complaints with Dell's XPS 13 2015 model is a slightly compressed keyboard and small keys. Its keys measure 14.7mm wide and tall. The ZenBook's are 16.2mm wide and 14.7mm tall. That may sound like nothing, but my typing was more accurate on the ZenBook's even though the keys felt a little spongy to my digits. If I were nitpicking, I'd note the lack of backlighting—and then Asus would just throw the \$699 price in my face and tell me where to go.

The trackpad on the unit appears to be an Asus design. My reference



Few corners seem to have been cut from the UX305 despite its price.

is the Google Chromebook Pixel's excellent etched-glass trackpad. This is not in the Pixel's class and has a definite metallic feel, but it's quite usable, and palm rejection on the default settings was quite good.

If you were looking for something else to complain about, it would be the wireless. Asus put in a dual-band 802.11n radio instead of 802.11ac. For most people it won't matter and is probably worth the trade-off for the extra RAM and storage.

Conclusion: The best deal in town

What this comes down to is a major change in price for an ultrabook. I thought Dell's XPS 13 2015, with its \$799 price was a big breakthrough, but you give up RAM and storage to get to \$800. The same goes with Apple's MacBook Air 11, which has a tiny, low-res screen and, like the Dell, a limited 128GB of storage and 4GB of RAM.

At \$699, the ZenBook sets a new standard in what to expect in a budget ultrabook. I dare say it feels like an injustice even to call this a budget ultrabook. In fact, maybe it's not that the ZenBook is low-priced, maybe it's that the others are overcharging you. 🙄



The new Retina display in the MacBook is easily surpassed in pixel density by this Lenovo Yoga 3 Pro.

Fight! 12-inch MacBook vs. Windows laptops

BY GORDON MAH UNG

WHEN APPLE'S MACBOOK Air made its debut in 2008, PC companies were caught utterly unprepared for what was arguably a ground-breaking moment in thin computing designs. With the world in financial ruin at the time, it would take years for competitors to catch up.

Apple is headed into a significantly different world with the launch of the new 12-inch MacBook (go.pcworld.com/12inmba), however. If anything, Apple is the one playing catchup with PC makers this time.

The Display

For an Apple ultra-light notebook, one of the most noticeable changes is the high-resolution “Retina” panel. The 12-inch display features an odd-duck resolution of 2304x1440 with an aspect ratio of 16:10. That’s a big leap for Apple, especially coming from a MacBook Air lineup that still features 1440x900 panels at best and embarrassing netbook-like resolution panels of 1366x768 at worst.

Also in the good news column, the MacBook’s panel is an IPS versus the TN in the two current MBAs. I know some professional photographers who don’t even bother to use MacBook Airs for color critical work because of the low resolution and lack of color accuracy in their displays. Apple also said the panel it selected uses more efficient and smaller transistors, so it uses 30 percent less power at the same brightness levels as its existing products.

The unique resolution tells me Apple likely had it custom designed and built to specs. Most PC vendors like to stick to standard aspect ratios to leverage the scale in prices. Since Apple will probably sell a killzillion MacBooks over the years, it probably doesn’t have to worry about it quite as much.

It’s not yet known yet, but it sounds like Apple’s panel could be an IGZO panel. IGZO panels are more efficient at transmitting light than

The Yoga 3 Pro is 12.7mm thick vs. the 13mm of the new Apple 12-inch MacBook.



Image quality, brightness, and the display's performance can't be judged yet, but on pure specsmanship, the MacBook's display is a me-too move.

a typical IPS panel so you don't have to drive the backlighting as hard for the same brightness. Image quality, brightness, and the display's performance can't be judged yet, but on pure specsmanship, the MacBook's display is a me-too move.

Again, it's not clear to me why Apple picked a resolution of 2304x1440 for the new MacBook Air 12. (Perhaps to balance power consumption?) That works out to a PPI of 226 and a pixel count of 3.3 megapixels. In the PC world, that's just average. The 13.3-inch Dell XPS13 has an option for a 3200x1800 panel with a PPI of 276 and a pixel count of 5.7 million. Similar-resolution panels are abundant in the PC world, too. The Lenovo Yoga 3 Pro also hits the same resolution as the Dell. Plenty of other notebooks and convertibles come close or supercede the resolution as well.

Like I said: On pure specsmanship, the 12-inch MacBook gets a big *meh* here. Apple fans, however, should cheer that they're finally able to get a high-res display in a thin-and-light laptop.

The form factor

Apple makes much hay about the size and weight of the new MacBook. It's basically 11 inches wide by 7.74 inches deep, with a maximum height of 13mm. (This, by the way, is how you crash Mars space probes: mixing standard and metric measurements.) Not bad.

I measured the thickest part of the Dell XPS13 at 18mm and the current MacBook Air 11 at 16.8mm. (Apple's specs actually say 17mm at the thickest part.) The XPS13 probably isn't the best representative though. The Asus Zenbook UX305 is about the same thickness as the 12-inch MacBook at 13mm. The Acer Aspire S7 and Lenovo Yoga 3 Pro are a smidge thinner at 12.7mm.



The new MacBook also sports an impressive 2 pound weight. That shaves about half a pound off most PC laptops. The Dell XPS13 and Yoga 3 Pro are about 2.6 pounds, as is the Asus Zenbook UX305. That makes the new 12-inch MacBook Air pretty light—just not the lightest.

That title will likely belong to Lenovo when it ships its LaVie HZ550 later this May. Using an IGZO panel and a magnesium lithium chassis, Lenovo has cut the laptop's weight down to 1.72 pounds. I hefted one at CES and thought it had been pumped full of helium. To be fair, though, the pre-production LaVie I tried didn't have the greatest keyboard and it wasn't super thin, at 16.9mm.

Performance

The new MacBook packs a fanless design using Intel's Broadwell-based Core M chips. There's an option for the 1.1GHz Core M, which I'm assuming is either the Core M 5Y51 or 5M 5Y70, or the 1.2GHz Core M 5Y71. I lined up the three potential chips over at Intel's ARK (go.pcworld.com/intelark) if you want to dive into the specs.

Core M chips are essentially low-power Broadwell chips that generate about a third of the heat of the Broadwell U processors used in many recent PCs. This lets vendors build truly fanless systems.

The Core M in the new 12-inch MacBook can't hang with faster (and hotter) Core i5 and Core i7 like this XPS13.

Losing the fan and living on a third of the thermals does significantly impact performance though. In Asus Zenbook UX305, I saw roughly a 25 percent performance hit over the XPS13 with a Core i5 5200U in it. The hit in graphics performance is far worse.

What's important here though is the design of the new MacBook. I've seen three Core M laptops, and so far, the performance is all over the map. It seems that either the skin temperature of the laptop get toasty and maintain good performance, or keep it cool and take a performance hit.

Core M is no Atom (although I have seen some numbers dip to the point where a desktop Atom can defeat it). For most of the tasks people use ultra portable laptops, you won't be able to identify it from a Core i5 or Core i7 CPU.

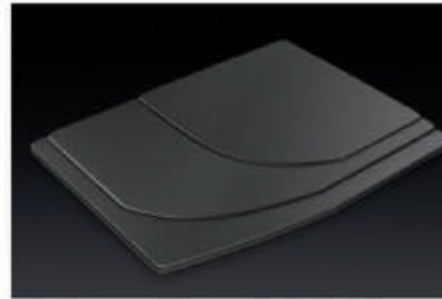
We'll have to wait to get a new MacBook for a final judgement on cross-platform performance. Is it even fair to pit a fanless notebook against one that's actively cooled? My gut says the Dell XPS13 will easily be all over the 12-inch MacBook from a performance perspective. But, it has a fan that makes its presence known.

Battery life and capacity

One of the 12-inch MacBook's unique touches is its batteries, which Apple claims to have built up in layers. Terracing the battery packs lets the company jam the maximum physical amount of battery capacity into the shell.

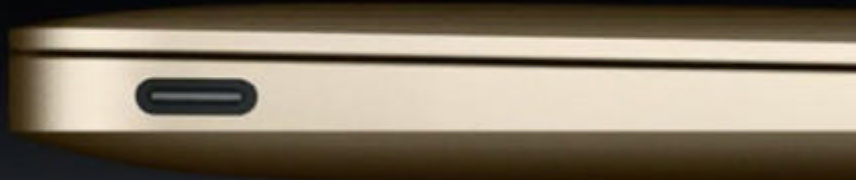
By the raw numbers, it seems to have worked. The 11-inch MacBook Air has a 38-watt-hour cell in it. The thinner and lighter 12-inch MacBook has 39.7 watt hour cell. Combined with the Core M chip, Apple claims it'll give you 9 hours of browsing and 10 hours of iTunes movies. (Who really uses iTunes to watch movies?) That's the same browsing rating as the MacBook Air 11 and one hour more in movie playback. You may say meh, but remember: The new MacBook packs a significant increase in resolution.

The original MacBook Air essentially has a one-megapixel display at



Apple's terraced lithium polymer cells let it stuff as much battery as possible into the 12-inch MacBook.

Up is down and white is black. Apple says one USB Type C is an improvement while most people complain about the lack of ports today.



1366x768. The new MacBook basically has triple its pixel count, yet slightly more battery life.

What about compared to PCs? That's not easy to do, and if you do, people will just choose to disagree. In run time, PC's can hang—but everyone's mileage will vary depending on what he or she does.

What are the PC's powered by? The Zenbook UX305 packs in a 45-watt-hour battery, while the XPS13 is running a 52-watt-hour job. HP's new Spectre x360 runs a 56-watt-hour cell.

Ports

On the 12-inch MacBook, there's but a single USB 3.1 Type-C reversible USB connector on the laptop, along with a combo analog audio port. No HDMI. No ethernet. No SD card slot—nothing else whatsoever. Maybe this is my personal bias, but give Apple credit for taking what would be seen as a limitation on a PC and turning it into a strength:

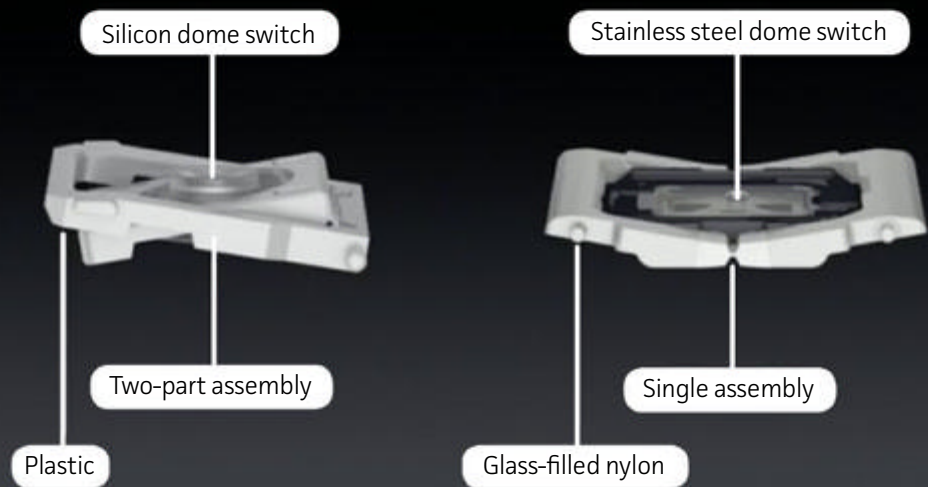
"Only one USB port and HDMI port on this ultrabook?! You suck, vendor X."

"Only one USB port that's not common at all on this new 12-inch MacBook? Wahoo! Apple does it again!"

I'm not sure who is actually asking for a reduction in ports on laptops, but I prefer more ports rather than fewer—especially common ports. Not having at least one standard Type-A USB port on the laptop itself is a weakness. Sure, there's a dongle adapter to make

the Type-C connection play nice, but if you lose that adapter, you're not going to copy a file from a USB drive to your laptop. Ask any IT department that issues Macs about lost dongles.

Lenovo's Yoga 3 Pro is thinner than the 12-inch MacBook at 12.7mm on paper (although I measured it just a tad thicker), but it has two Type-A USB ports, analog audio, a microHDMI connection, and an SD card reader on its side.



Apple's new butterfly switch is designed to make the keys larger and more stable while also making them thinner.

Keyboard and trackpad

Here's an area where Apple looks to have an early advantage over PC vendors. The company said it designed a "butterfly" switch for the MacBook's keyboard instead of using the standard scissor keyboard switch that's been used on laptops for the last two decades. Apple says the switch is more stable and thinner and allows for larger keycaps.

These are all good things. It's an area where PC vendors may have to work hard to catch up. But PCWorld's resident keyboard expert Hayden Dingman reminds us that there have been plenty of variations of scissor

switches over the years. Razer, for example, has been playing with laptop switch designs and designed two different types of switches for its Razer Blade and Razer Blade Pro. No matter how good a laptop keyboard gets, it'll never be a mechanical keyboard.

The trackpad may also be a competitive advantage for Apple, with its feedback system. Pressure sensitivity isn't really new—Synaptic's ForcePad is one example that's been available on PCs for years.

Still, this is one area where Apple usually brings its A-game, and PC vendors will likely have to find a way to respond if people report the MacBook's keyboard knocks it out of the ballpark.

Price

The new MacBook is \$1,300 with a 1.1GHz dual-core processor and a 256GB SSD, or \$1,600 to go to 1.2GHz dual-core processor and a 512GB SSD. All models feature the same 12-inch high-resolution panel and 8GB of DDR3L/1600 RAM.

What does those prices get you in the PC world? Asus Zenbook UX305 with its Core M, 8GB of RAM and 256GB SSD: \$699. The Dell XPS13 with 3200x1800 touch screen, 8GB of RAM, 128GB SSD, and more capable Core i5 processor is \$1,300. HP's new Spectre X360 with a hulking, Core i7, 8GB of RAM, 256GB SSD, and 1920x1080 screen is \$1,150.

Conclusion

Unlike in 2008, the 12-inch MacBook won't be flying into unclaimed territories when it goes on sale in April. Instead, there will already be companies camped out with laptops that are cheaper and—on paper, at least—better.

That said, the new MacBook does seem to hit a lot of the high points that people want: a good keyboard, a good trackpad, a higher-resolution screen that doesn't ruin battery life, and feathery weight. It'll be interesting to see how Apple's newcomer stacks up when it hits the real-world streets. 🍏

Information capture taken to a new level

BY JON L. JACOBI

IF YOU WANT to capture all the information from a meeting, class or lecture, there's no better tool than Toshiba's Encore 2 Write (go.pcworld.com/encore2).

The Encore 2 Write features an active stylus for accurate scribbling, but the magic is in a unique set of bundled apps: TruNote mimics Microsoft's OneNote but performs very accurate handwriting recognition on the entire documents,



**Toshiba
Encore 2
Write**

TruCapture OCRs images captured using the unit's 5MP camera, and TruRecorder splits audio recordings into timelines for each orator to facilitate.

Price and design

The \$349 10-inch, 1280x800 Encore 2 Write WT10PE-A that I looked at is a light (about 1.25 pounds), Atom Z3735F-based tablet with 2GB of memory and a 64GB eMMC SSD. The rear camera is 5MP and the Webcam 1.2MP. The Wi-Fi is 802.11 a/b/g/n and there's Bluetooth 4.0 on board. It's easy to hold, easy on the eye, and comes with the aforementioned active stylus monikered "TruPen." The TruPen is one of the nicer styluses I've seen, with a cap that protects the nib when it's not in use.

The TruPen makes use of Wacom's ActiveES, which unlike that

company's traditional pressure sensitive tablets, uses the pen to relay location, pressure and other information. Just in case you were wondering "Why not use your finger?" You can, but a stylus allows you to fit far more in the same amount of space and with considerably less hand movement. And the pressure sensitivity is great for mimicking real drawing tools with apps that support it.

The Atom-based

Encore 2 Write integrates a Wacom digitizer.



Toshiba Encore 2 Write

PROS:

- Accurate stylus input
- Impressive handwriting recognition

BOTTOM LINE:

I heartily recommend it over the regular Encore 2, which is just another Windows tablet, albeit a very affordable one.

\$350

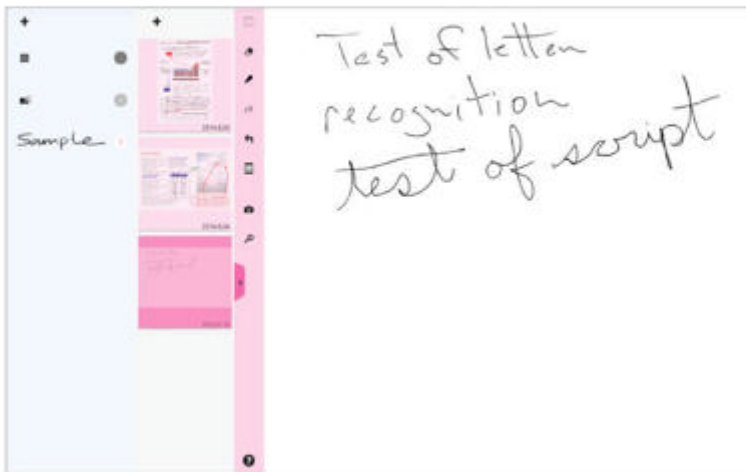


As Windows tablets are ostensibly business oriented, you might want to opt for the Surface-like \$109 Bluetooth keyboard-case. I wish there was a kickstand so I could use the Encore 2 Write with one of my existing Bluetooth keyboards. Small sigh.

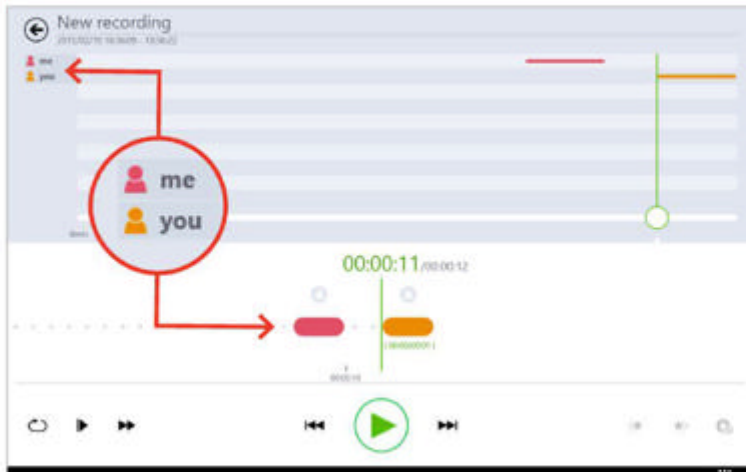
Apps and note-taking

The Encore 2 Write-Tru-app experience as envisioned by Toshiba is that you take notes and scribble using the TruPen within TruNote, capture whiteboards and the like with the camera within TruCapture, and record any verbal discussions or orations with TruRecorder. You then process the notes and images into text and the audio into individual conversational threads after the fact. Meetings, lectures, classes...Never miss a thing. Sweet.

However, having lived through the handwriting recognition wars and disappointments back in the day, I was duly skeptical about TruNote. Well, strap two wire hangers to my head and call me an antenna—the bad old days are no more. I opened a text file created from one of my notes in the bundled TruNote application and every last thing I scribbled was accurately translated. No mistakes. Color me impressed. Scribbling then having your entire document recognized



TruNote does a bang-up job of deciphering handwriting and saving it as text.



TruRecorder

separate different speakers in a conversation to make searching audio recordings quicker.

post facto is a far smoother experience than entering info piecemeal with Windows 8.1 pen entry grid.

On the other hand, the OCR of photos in the TruCapture app was just okay. It recognized text fairly well, but it doesn't recreate documents with images, specific fonts, and so forth as Adobe Acrobat and Nuance's OmniPage attempt to do, often succeeding. TruCapture is useful; it's just simply limited in scope. Also, while the camera is great for taking photos of whiteboards, blackboard, billboards and the like, it was difficult getting a document page in focus and to get an 8.5 by 11 page entirely in frame. You need to hold the tablet steady, a good foot away. It's not impossible, but not easy.

Toshiba bundles another very useful business app—TruRecorder. It's an audio recorder that divvies up audio captures according to who was speaking. Theoretically, the time you could save when looking for a specific quote is substantial. However, the processing wasn't as accurate as I would've wished in my tests. This was perhaps due to ambient noise and the two female participants sounding much the same, but they were still mistaken for myself. And no, I don't sound like a girl.

While I found the note-taking and image and audio capturing and processing very handy, where I really had a blast with the Encore 2


Write was with what styli are traditionally very good at—drawing. You can't really appreciate a program such as Microsoft's Fresh Paint until you employ an active stylus. I'm no artist, but I managed some pretty decent drawings by my woeful standards.

Performance

The Encore 2 Write is only a mediocre performer, which is the normal for anything Atom-based with a slow SSD. It functions fine as a tablet, but there is a slight lag opening programs so don't expect wonders when it comes to large databases, spreadsheets, and video rendering.


PC Mark 8 rated the Encore 2 Write at 1489 in the Work test and 881 in the Creative test. With 3DMark it was fine with Ice Storm Extreme and its Web-grade graphics, but nothing more taxing. The eMMC SSD scored 97MBps reading and 47MBps writing large files in CrystalDiskMark. That's quite slow, but this is a tablet and PC Mark also measured the run time at approximately 7 hours, 22 minutes. Not bad at all. 1080p movie playback was quite good as well, but the sound emanating from the speakers was a tad distorted at anything above minimum levels.

Conclusion

With accurate stylus input and the apps Toshiba bundles, the Encore 2 Write turned out to be a far more useful tool than I'd expected. Until Microsoft adds whole-document handwriting recognition to OneNote instead of just OCR, it should remain the avatar for live information capture. 



With accurate stylus input, and the apps Toshiba bundles, the Encore 2 Write turned out to be a far more useful tool than I'd expected.



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Dell Venue 8 7000: thinner than iPad Air 2

BY FLORENCE ION

I HAVE TO BE honest here. I've only ever really known Dell as a PC maker. The company's laptops were once a staple on my college campus for those who couldn't afford a fancy Apple Powerbook, and now some of my colleagues even use a Dell laptop as their daily driver.

So you can imagine my surprise when a Dell-branded Android tablet showed up at my desk with some supreme specifications and Intel's latest Atom processor. While the words "Dell" and "Intel" don't exactly conjure up the image of an Android tablet, I'm open to

trying out new things. Dell's new Venue 8 7000 (the exact model number is 7840, go.pcworld.com/venue87000) scored high marks in its design and functionality. But some of the extra stuff bundled with it,

like Intel's RealSense camera technology, seems like it could really use a little more polishing.



Dell Venue 8 7000

PROS:

- Stunningly gorgeous OLED display
- Extremely light
- Thinner than an iPad Air 2

CONS:

- Color distortion in the OLED display at lowest brightness
- Intel still seems to be figuring out what RealSense is useful for

BOTTOM LINE:

If you're teetering between an iPad and an Android tablet, give the Venue 8 7000 a try. But if you're a seasoned Android user, there are more powerful, better looking tablets out there.

\$399



Thin, but not flimsy

For the most part, I've been unimpressed with Android tablet design. Most of what manufacturers have brought to market have been basic looking, save for Samsung, which introduced its attractive Galaxy Tab S series last year specifically to compete against Apple's iPad.

The Dell Venue 8 7000 is still a bit behind where Samsung is at, though it definitely has an air of originality about it with its gunmetal chassis and black glass accents. At 6mm, it's thinner than the iPad Air—though only by 0.1 mm—and one of the lightest tablets I've ever held.

Despite its weightlessness, the tablet isn't comfortable to hold. It may sound pedantic, but the top-left placement of the power and volume buttons are completely opposite of what I'm used to (though I

could see left-handers getting excited about that). The bezels are so thin that I kept accidentally activating the screen while I was trying to read an ebook. You can certainly hold the tablet by its bottom chin where the speakers are housed, but it's sort of awkward to do so in landscape orientation, and when you're ready to shoot a selfie, you have to flip the tablet upside down to do so.

Just to show you that it hasn't left behind its PC-making past, Dell even slapped on its huge logo on the back so that everyone on the train ride to work can see that you're still buying products from the same company that made your college laptop.

The Dell Venue 8 7000
sports a gorgeous
OLED display.



A sharp display with noticeable flaws

At first glance, the Venue 8's 8.4-inch, 2560 x 1600 resolution OLED panel is truly a thing of beauty—I loved doing even mundane things on it, like reading a graphic novels or watching YouTube. Dell's display isn't as over-saturated as Samsung's displays, and the picture is always nice and clear at medium-to-high brightness levels.

Unfortunately, it doesn't seem Dell properly calibrated the tablet's display. I noticed a nasty color distortion with the brightness turned all the way down while using the tablet in low-light. The display takes on a purple tint, contrast all but disappears, and apps like Google Keyboard look as if they'd been improperly colored.

It's what on the inside that counts

The Venue 8 runs near-stock Android 4.4.4 KitKat, though Dell bundled in some extra applications that are a bit tacky looking. In particular, the MaxxAudio app, an equalizer for the Venue 8's awesome stereo speakers, sports an interface that's stuck in 2010. But again, it is what helps make the tablet great for bumping out loud tunes, so it's a transgression worth overlooking.

As far as operating system performance goes, you won't experience any slowdowns with the tablet's quad-core 2.3GHz Intel Atom Z3580 processor and 2GB of RAM.

Since this is my first time with an Intel-based Android tablet, I



...the MaxxAudio app, an equalizer for the Venue 8's awesome stereo speakers, sports an interface that's stuck in 2010.

decided to run the device through a few benchmark tests. It scored lower than the Nexus 9's 64-bit Tegra K1 processor in both Geekbench 3 and 3DMark, and about average in Vellamo's Chrome and multi-core benchmarks. It's still really speedy, though, and about the only time I really experienced lag was after I'd snap a photo using Intel's RealSense camera.

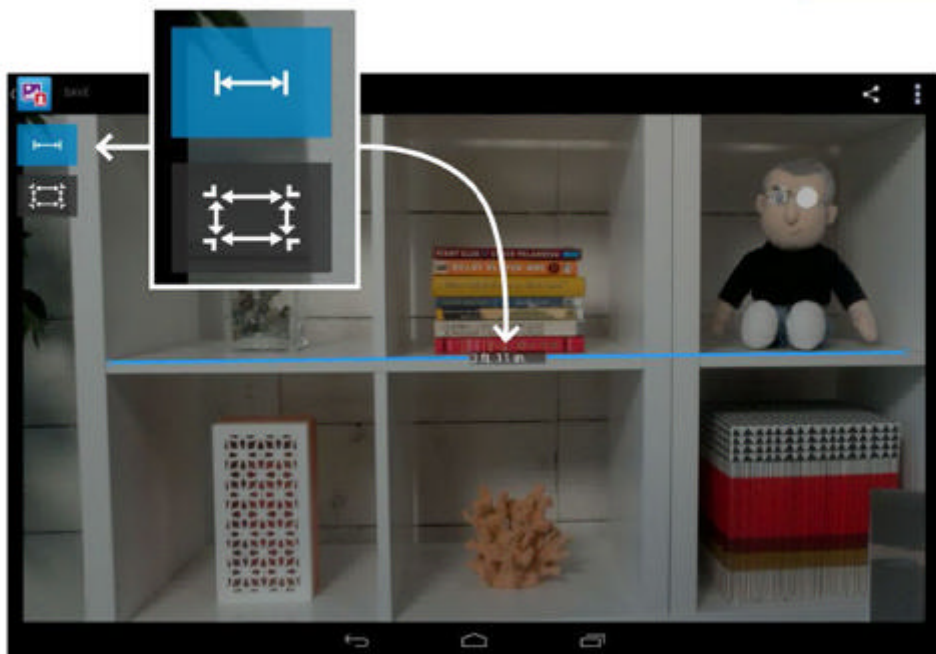
The Venue 8 7000's 5,900 mAh battery pack seemed to last forever on standby. I'd leave it alone over the weekend and it'd only eat through about three percent of battery life. I did notice that the brighter the screen the quicker the battery would

Scores & Comparison		
<i>(-, +, =) Icons indicate comparison with your device.</i>		
Score	20517 (20217)	=
Graphics score	20465 (20071)	=
Physics score	20701 (20917)	=
Graphics test 1	99.6 FPS (98 FPS)	=
Graphics test 2	80.4 FPS (79 FPS)	=
Physics test	65.7 FPS (66 FPS)	=
OS Version	4.4.4	

The Venue 8 7000's
3DMark scores.

Geekbench Score				
943		2732		
Single-Core Score		Multi-Core Score		
Section	Description	Single-Core	Multi-Core	Multi-Core
Integer	Processor integer performance	1026	3275	3275
Floating Point	Processor floating point performance	840	2928	2928
Memory	Memory performance	983	1257	1257
Geekbench 3.3.1 for Android x86 (32-bit)				

The Venue 8 7000's Geekbench 3 score.



drain. But for the most part, I could leave the tablet behind and come back a few days later and it'd still have a little juice left.

RealSense makes no sense

Intel's RealSense is definitely first generation technology that's in the process of establishing what it's capable of. The technology uses the rear-facing 8-megapixel camera and two accompanying 720p cameras that record depth information. Thus far, it can measure distance, change a focus point, and colorize or filter a specific part of a photo.

The three rear-facing cameras are too easy to block with your fingers when you're taking a photo, and for the depth-sensing to really work you'll have to situate yourself far away from the subject to get it to fit in the frame.

The measuring tool is also a neat utility to have, but I'd rather see this technology on a smartphone than a tablet. You shouldn't be snapping many photos with your tablet, anyway.

You can use
the camera to
measure real
life things.

A good start from Dell

If you're the type of person who wants to buy a tablet from the same company that makes the laptop your IT department issued to you, then I think you'll like the Dell Venue 8 7000. It's a formidable competitor to Apple's iPad, and its thin chassis will at least give you some bragging rights.

If you're a seasoned Android user, Samsung's Galaxy Tab S is still the one to consider. It may not be as speedy as the tablet reviewed here, but it's a bit more trustworthy given Samsung's time in the Android realm. Or, if you're really power hungry, there's the Nexus 9.

Regardless, this is an improvement over Dell's previous tablets. Between its manufacturing power and Intel's storied hardware past, the two companies could be on to something here. They just both need to stay focused if they want to become a top contender. 🏆

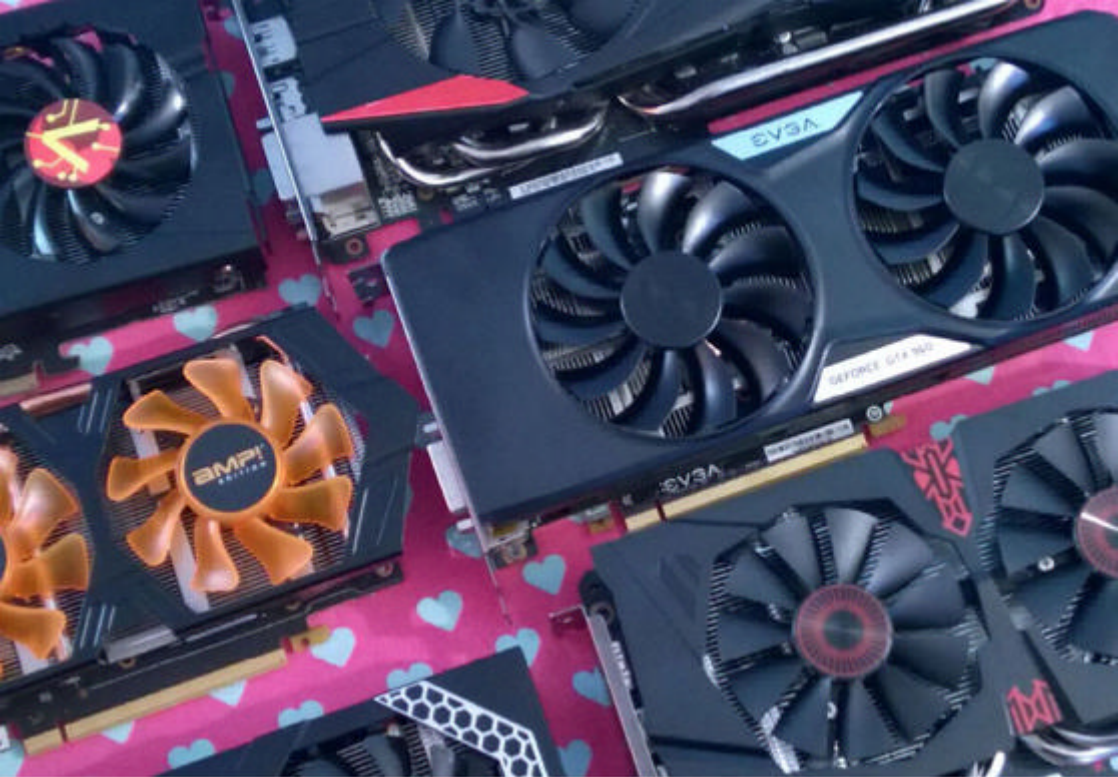
How many light bulbs does it take to change an American?



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Nvidia GeForce and AMD Radeon graphics cards for every budget

BY BRAD CHACOS

WHAT GRAPHICS CARD within my budget gives me the best bang for my buck? That single sentence cuts to the core of what people on the hunt for a new graphics card are looking for: The most *oomph* they can afford. Sure, graphics cards are complicated pieces of technology, powered by billions of transistors and countless other types of intricate hardware, but people just want to crank the detail settings on *Far Cry* and just plain play.

Answering the question can be a bit trickier than it seems. Raw performance is a big part of it, but factors like noise, the driver experience, and supplemental software all play a role in determining which graphics card to buy.

I tested graphics cards of all shapes, sizes, and price points to nail down exactly what you can expect for your money—from itty-bitty \$90 cards to gargantuan, \$700 behemoths with not one, but

two graphics processors and custom watercooling loops. In addition I've included "extras" that can sway your buying decision, like Nvidia's ShadowPlay software and AMD's performance-boosting Mantle API.



The gear we used for testing

- Intel's Core i7-5960X with a Corsair Hydro Series H100i closed-loop water cooler
- An Asus X99 Deluxe motherboard
- Corsair's Vengeance LPX DDR4 memory
- Obsidian 750D full tower case
- 1200-watt AX1200i power supply
- A 480GB Intel 730 series SSD
- Windows 8.1 Pro

Our test rig

It's powerful—and definitely overkill for gaming—but that eliminates potential bottlenecking situations in the system. For more information you can check out our build guide (go.pcworld.com/diygamingpc) for PCWorld's graphics testing PC.

We tested as many different GPUs as possible—one GeForce GTX 750 Ti, one Radeon R9 290X, and so on—with a preference for models with custom cooling solutions, in order to mimic as



AMD's Radeon R7 250X



EVGA's GeForce GTX 750 Ti Superclocked

realistic a scenario as possible. A couple of high-end reference cards are also included.

Models of all current Nvidia GPUs have been benchmarked, but you'll notice some missing Radeon models, such as the R7 260X and the R9 285. This is due to a few things: PCWorld's graphics card review coverage was light the past couple of years, and AMD hasn't released much new graphics hardware since fall 2013. Plus, the Radeon R-series has a lot of different GPUs! We gathered as many models as we could.

The graphics cards we tested

AMD Radeon R7 250X While various models with 1GB of RAM can be found for around \$80 online, we tested a slightly more expensive (now apparently discontinued) Asus R7250X-2GD5 with 2GB of GDDR5 RAM paired with a 128-bit memory bus, a custom dual-fan cooling solution over a large heatsink, and Asus' typically outstanding build quality. (I love how the company etches connection names into the metal next to each port!) The 95W card is clocked at 1.02GHz, packs 640 stream processors, and requires a 6-pin power connection. For ports, there's DVI, VGA, HDMI, and DisplayPort.

EVGA's GeForce GTX 750 Ti Superclocked Most models cost between \$120 and \$160, depending on the included features. Stock specs include a 1020MHz base/1085MHZ boost clock, 640 CUDA cores, and 2GB of GDDR5 memory paired with a 128-bit bus. We

tested a \$150 (after rebate) EVGA GeForce GTX 750 Ti Superclocked, which ships factory-overclocked at 1176MHz base/1255MHz boost. It includes single HDMI, DisplayPort, and DVI-I connections, but here's the really nifty thing about the 750 Ti: This power-sipping graphics card requires no supplemental power connections whatsoever. It draws all its juice over the PCIe connection.

HIS's Radeon R9 270 The AMD Radeon R9 270 has clock speeds up to 925MHz, up to 1,280 stream processing units, and up to 2GB of GDDR5 memory over a 256-bit bus in stock configurations. Online prices range from \$130 to \$150 after rebates and discounts. We tested a \$150 HIS model with the company's custom IceQ X2 cooling solution, dual BIOSes, and other overclocking-friendly features, though it's rocking stock clock speeds. It needs a 6-pin power connection and packs HDMI, DVI, and a pair of Mini-DisplayPort connections.



HIS's Radeon R9 270



VisionTek's Radeon R9 270X

VisionTek's Radeon R9 270X The thirstier AMD Radeon R9 270X needs two 6-pin power connections, but it offers up to 4GB of RAM and 1050MHz clock speeds with the same 1280 stream processors. Prices typically range from \$150 to \$200 online. The \$190 VisionTek model we tested packs 1030MHz base/1080MHz boost clock speeds, a custom dual-fan cooling solution over a beefy heat sink with supplemental heat pipes, and a killer limited lifetime warranty for both parts and labor. It packs HDMI, DisplayPort, and both DVI-I and DVI-D connections.

Zotac's GeForce GTX 760 AMP! Edition

The Nvidia GeForce GTX 760 has been discontinued in favor of the newer GTX 960, but we're still including it in the roundup. Stock specs include 1,152 CUDA cores, 980MHz base/1033MHz boost clocks, and 2GB of RAM over a 256-bit bus. Power is delivered over a pair of 6-pin connectors.



Zotac's GeForce GTX 760 AMP! Edition

The card we tested was overclocked to a hefty 1111MHz base/1176MHz boost clock, cooled by a custom dual-fan solution with a trio of copper heat pipes snaking out of a full-width heat sink. It has HDMI, DisplayPort, DVI-I, and DVI-D connections.

EVGA's GeForce GTX 960 Super SC The newer \$200-and-up Nvidia GeForce GTX 960 packs the newer, supremely power-efficient Maxwell GPU architecture that first appeared in the GTX 750 Ti. While stock versions of these cards, which has 1,024 CUDA cores, are clocked at 1127MHz base/1178MHz boost. This energy efficiency allows graphics cards makers to apply beefy overclocks out of the box.



EVGA's GeForce GTX 970 FTW with ACX 2.0

The two cards we tested—the \$210 EVGA GTX 960 Super Superclocked and \$210 Asus GTX 960 Strix DirectCU II—are clocked at 1279MHz/1342MHz and 1253MHz/1317MHz, respectively. The former requires an 8-pin power connector, while the latter needs a 6-pin. You can find more details in PCWorld's GTX 960 review.

Asus's Radeon R9 280X Firect CU

TOP II

The AMD Radeon R9 280X is essentially a faster, smarter, cheaper version of the previous-generation Radeon 7970 GHz Edition flagship. With 2,048 stream processors, the stock version packs 3GB of memory over a 384-bit memory bus and an 850MHz

base/1000MHz boost clock. Prices range from \$230 to \$250 online after discounts and rebates. The \$230 Asus model we tested pushes the boost clock to 1070MHz and sports Asus' excellent DirectCU II TOP custom cooling system. The card requires one 6-pin and one 8-pin power connector and offers HDMI, DisplayPort, and DVI-D and DVI-I ports.

The card packs 2,560 stream processors and 4GB of RAM with an ultra-wide 512-bit memory bus. It rocks a 662MHz base clock and 947MHz boost clock, with the same power pin setup as the R9 280X. These cards pack HDMI, DisplayPort, and dual DVI-D connections and in the wake of the GTX 970's launch can frequently be found for \$240 through \$270. We tested a reference model supplied by AMD.



Asus's Radeon R9 280X Firect CU TOP II

EVGA's GeForce GTX 970 FTW with ACX 2.0

This card boasts 1,664 CUDA cores, 4GB of RAM (ish) over a 256-bit bus, and a 1050MHz base/1178MHz boost clock. Prices start at \$330. We tested an EVGA GeForce GTX 970

FTW with ACX 2.0 cooling, which—as the name implies—utilizes EVGA's quiet, long-lasting ACX 2.0 cooling technology and boosts clock speeds to a hefty 1165MHz base/1317MHz boost, with plenty of room left for overclocking. This card delivers such a compelling



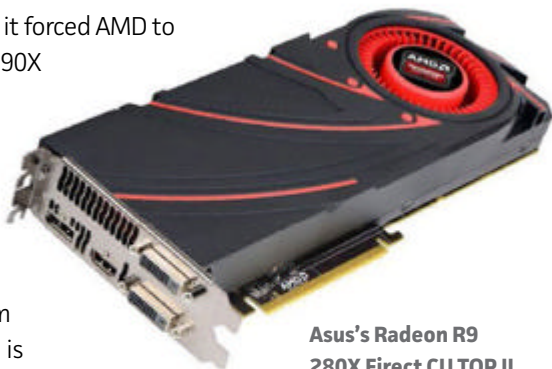
**Asus's Radeon R9
280X Firect CU TOP II**

price-to-power-to-performance ratio that it forced AMD to drop prices on its flagship R9 290 and R9 290X graphics cards by hundreds of dollars.

AMD's reference Radeon R9 290X

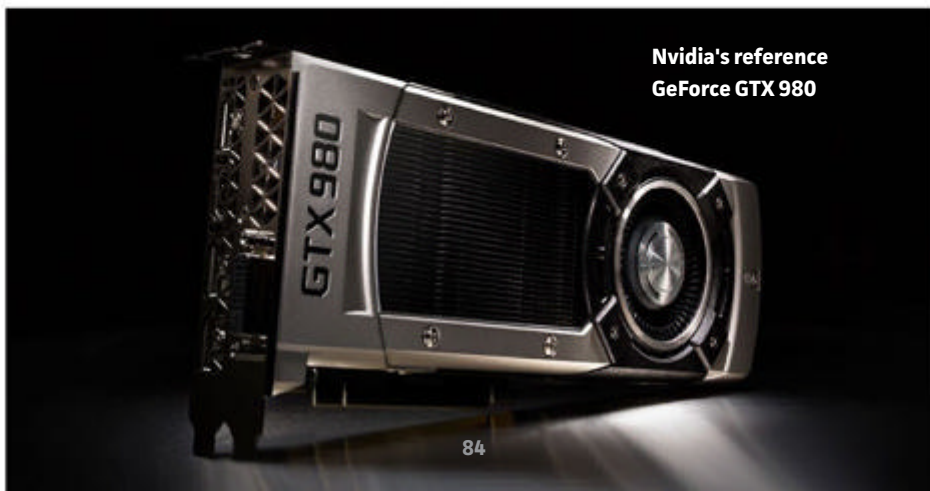
The reference Radeon R9 290 is identical in appearance. AMD's flagship single-GPU graphics card, the Radeon R9 290X, rocks 2,816 stream processors. The card's base clock speed is 727MHz, which boosts to 1000MHz when needed.

Like the R9 290, its RAM utilizes a spacious 512-bit memory bus, with both 4GB and 8GB versions available. Versions with 4GB of RAM can be found for \$300 to \$350 in the wake of the GTX 970's launch; add another \$100 for 8GB models. The R9 290X has the same power requirements and port configuration as the R9 290. We tested a reference model supplied by AMD.



**Asus's Radeon R9
290X Firestorm CU TOP II**

Nvidia's reference GeForce GTX 980 Nvidia's single-GPU flagship, the GeForce GTX 980, is powered by 2,048 CUDA cores. It features the same 4GB of RAM and 256-bit bus as the GTX 970, with clock speeds of 1126MHz base/1216MHz boost. You'll need a pair of 6-pin

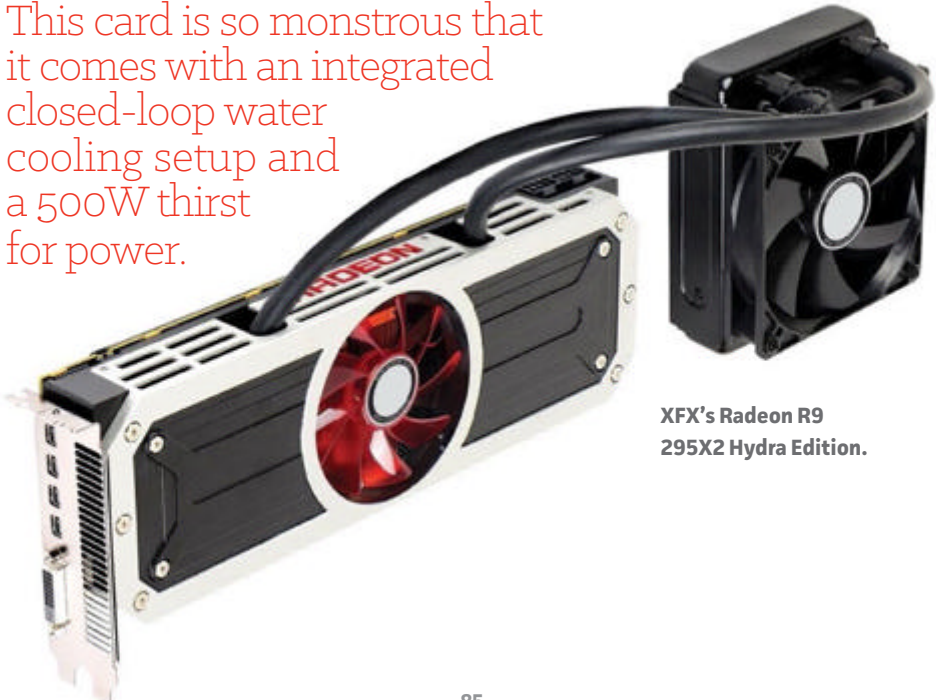


**Nvidia's reference
GeForce GTX 980**

connectors to power this 165-watt card, which sports HDMI, DVI-I, and three DisplayPort connections.

XFX's Radeon R9 295X2 Hydra Edition Finally, we have an utter beast of a graphics card, the borderline ludicrous AMD Radeon R9 295x2, which rocks two—count 'em, two—of the graphics processors found in the Radeon R9 290X. This card is so monstrous that it comes with an integrated closed-loop water cooling setup and a 500W thirst for power. You'll want a spacious case and a 1200W-plus power supply with two free 8-pin power connectors to run it. In exchange, you get 5,632 stream processors, 8GB of RAM with a 512-bit bus, a 1018MHz clock speed, and enough firepower to chew through any game without breaking a sweat. We tested an XFX Hydra Edition model.

This card is so monstrous that it comes with an integrated closed-loop water cooling setup and a 500W thirst for power.

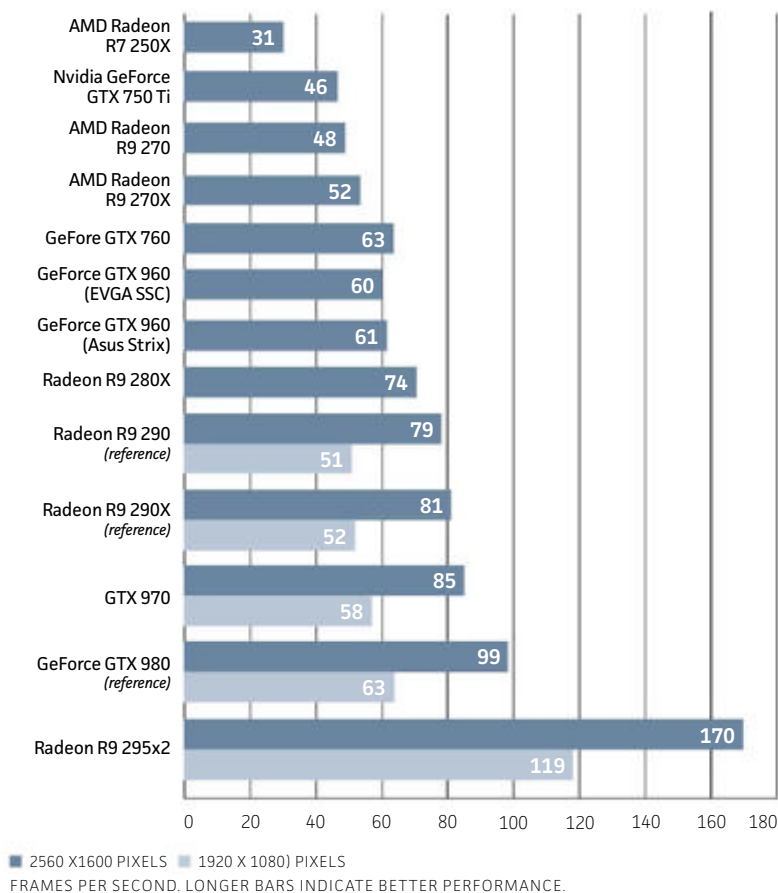


**XFX's Radeon R9
295X2 Hydra Edition.**

By the numbers

We subjected every card to a gauntlet of synthetic benchmarks and real-world games to try and answer the question, measuring power use all the while.

Bioshock Infinite (ultra image quality plus diffusion depth of field enabled)



A couple of quick notes: All Radeon R9 290X figures are in “Uber” mode. Transitioning the card to “Quiet” mode usually resulted in only about a 1 frame-per-second difference in our tests. Results for the EVGA GTX 960 SSC are using the default “dBi BIOS.” Switching to the card’s “SSC Performance BIOS”

typically improved frame rates by 1 to 3 fps in our games suite, with one glaring exception: The EVGA SSC hit 60.18 fps in *Bioshock Infinite* in dBi, but that leaped to a whopping 76.01 fps with the Performance BIOS.

I tested first with *Bioshock Infinite*, an old standby that serves as a great stand-in for the Unreal 3 Engine. Unreal 4 has been announced, but it hasn’t begun showing up in mainstream games yet. A zero frames per second score in these graphs means we didn’t test the game at that resolution and graphics setting with the particular card.

Next, the recent remaster of *Sleeping Dogs: Definitive Edition* cranked the graphics to 11. Even modern graphics cards have troubles hitting 60fps with details settings turned up. In fact, none did in our tests. Seeing the Radeon R9 295X2 top out at 50.7fps at 1080p was a bit perplexing, but the result was the same after multiple retests. Interestingly, it hits similar frame rates at 2560x1600 resolution, which pushes around twice as many pixels as 1920x1080.

Likewise, *Metro: Last Light Redux* is a remake of the superb *Metro: Last Light*. It runs on 4A Games’ custom 4A Engine. We tested the game with SSAA disabled. The feature cuts frame rates in half—and the game looks gorgeous enough without it. For more details, see our benchmarks (go.pcworld.com/gcbenchmarks) featuring *Sleeping Dogs 2560*, *Metro*, *Middle-earth*, *Sniper Elite*, *Alien Isolation*, *Unigine Valley*, and *3DMark Fire Strike*.

Transitioning the card to “Quiet” mode usually only resulted in about a 1 frame-per-second difference in our tests.

Power use and temperature tests

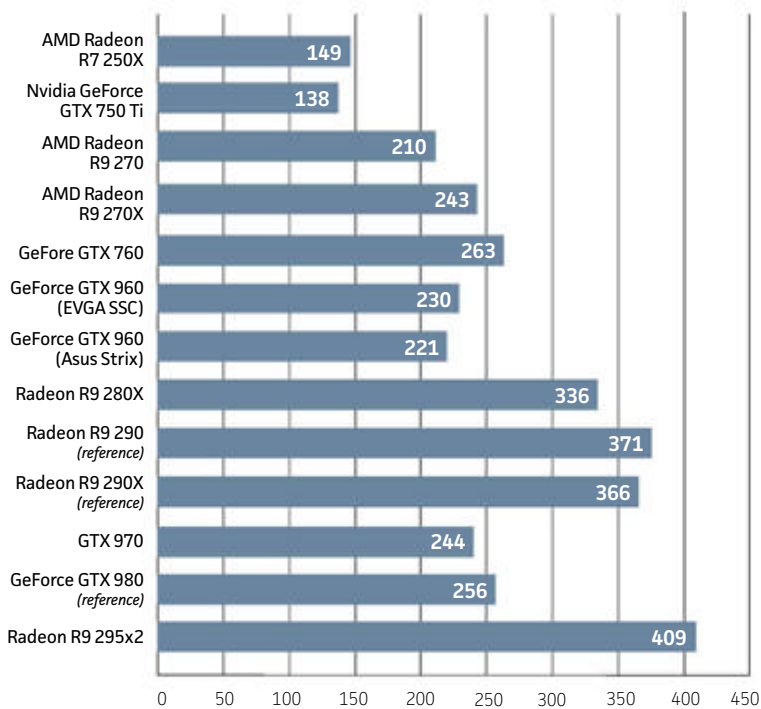
We’d be remiss not to talk about the power efficiency and temperatures of these GPUs. Nvidia’s Maxwell GPU architecture is a

power-sipping savant. AMD's R9-series graphics cards run hot and loud in comparison, though models with aftermarket coolers are still plenty quiet for everyday gaming.

Note that this is the power use of the entire system under load, not just the GPU. Baseline system power use varies between 73W and 80W depending on the graphics card. The temperature measurement is of the graphics card only, however.

Temperature-wise the dual GPUs of the Radeon R9 295X2 gobble electricity like it's going out of style, but despite that the

System power use (in watts, under full load)



HIGHER WATTS INDICATE MORE POWER CONSUMPTION.



integrated water cooling setup helps the behemoth run remarkably cool and quiet. See the full temperature chart (go.pcworld.com/gcbenchmarks).

Extra! Extra!

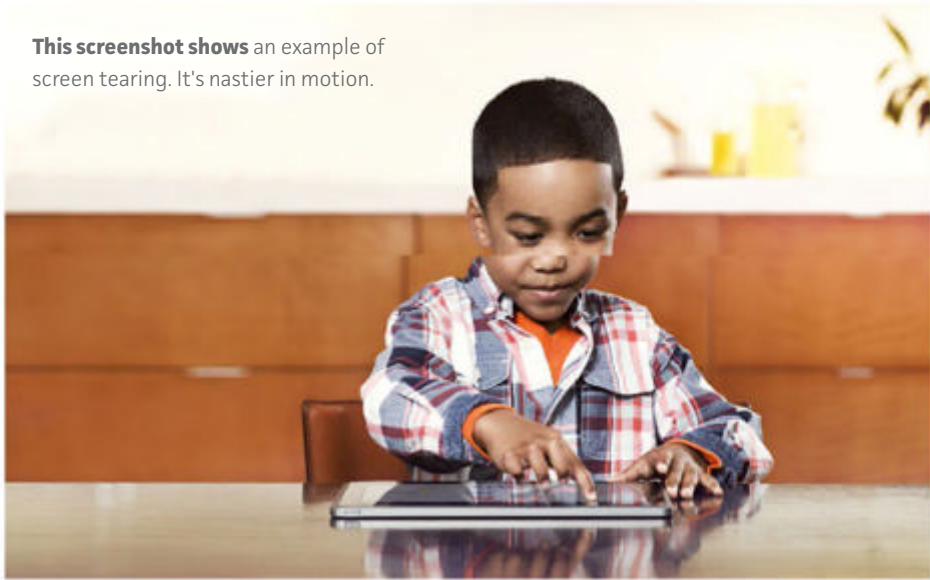
Beyond raw performance stats, both AMD and Nvidia offer a slew of extra features—normally software-related—to coax you toward Team Red or Green, respectively.

Some of those features are common to both companies, though each naturally puts its own brand on the technology and the technical implementations may be slightly different. Two relevant, standout examples: high-resolution downsampling and the quest to eradicate pesky screen tearing artifacts.

Recent graphics cards from both AMD and Nvidia allow you to choose to render games at resolutions higher than what your monitor actually supports—all the way up to 4K resolution—then apply a filter to downsample the image to your display's native resolution in real time. Doing so provides a far crisper picture than

This screenshot shows the power of NVidia's Dynamic Super Resolution. Note the image quality of the grasses.

This screenshot shows an example of screen tearing. It's nastier in motion.



you'd usually see, and you won't have to muck with anti-aliasing, either. On the downside, rendering games in such high definition can put a *big* hurt on your frame rate, so you'll only want to do this in games where you're seeing *ridonkulous* performance already.

Nvidia's implementation is dubbed Dynamic Super Resolution, while AMD calls theirs Virtual Super Resolution.

Both companies are also trying to eliminate screen tearing and stuttering by forcing your graphics card and your monitor to synchronize their refresh rates. Each implementation requires compatible monitors, however. Monitors supporting Nvidia's G-Sync technology have already started to appear on store shelves, but G-Sync requires an extra hardware module that drives up the cost of the display. AMD's FreeSync can work over a standard DisplayPort 1.2a connection—no extra hardware (read: cost) required—but compatible displays have yet to hit the streets.

With that out of the way, here's an overview of some of the highlight features for each individual brand.

Nvidia has a few aces up its sleeve

On the hardware front, the new Maxwell GPU architecture is vastly superior to AMD's R9-series cards in terms of thermals, noise, and power efficiency. It's a night-and-day difference. If you're building a power-constrained computer or a small form-factor PC where heat is a major concern, you'll want to consider going with an Nvidia graphics card.

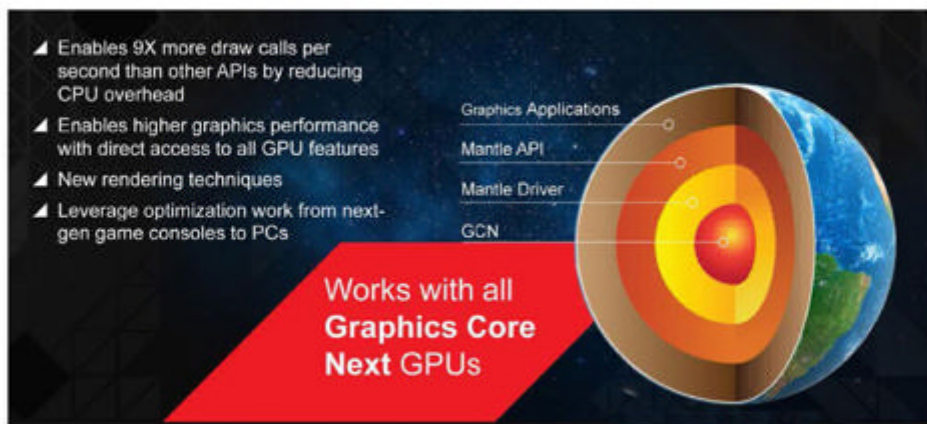
Nvidia's GameStream technology lets you stream full-blown PC games to a Nvidia Shield handheld or tablet, which you could then connect to your TV for a living room gaming sessions if you wanted to. GameStream holds up very well, streaming games at low latency on home networks. It's slightly less useful now that Steam's killer in-home streaming feature is live and rockin', however.

Some software features also stand out. Nvidia's ShadowPlay is hands-down the best option for video recording your gaming sessions,



Nvidia's GameStream

technology lets you stream your full-blown PC games to an Nvidia Shield handheld or tablet.



An AMD slide describing some of Mantle's high-level advantages.

delivering practically no hit on frame rates. Next, Nvidia's multi-frame-sampled anti-aliasing (MFAA) smoothes out jagged edges similarly to traditional multi-sample anti-aliasing, but with far less of a performance impact—giving you the same level of eye candy with a decent-to-big frame rate boost. MFAA works in any DirectX 10 or DX11 game that supports MSAA; in fact, Nvidia's GeForce Experience software enables MFAA by default in compatible titles.

Speaking of GeForce Experience, most gamers give Nvidia the edge when it comes to software polish and driver support, though AMD's working hard to dispel that belief with initiatives like the recent Catalyst Omega driver.

AMD holds some key advantages as well

Most notable software-wise is Mantle, a graphics API that grants game developers "closer to the metal" access to Radeon hardware and eliminates CPU bottlenecks. In the right hands and with the right CPU/GPU configurations, the frame rate increases can be downright staggering. Developers can also opt to use Mantle to deliver far smoother performance rather than staggering frame rates when you're using a multi-GPU CrossFire setup, as Firaxis chose

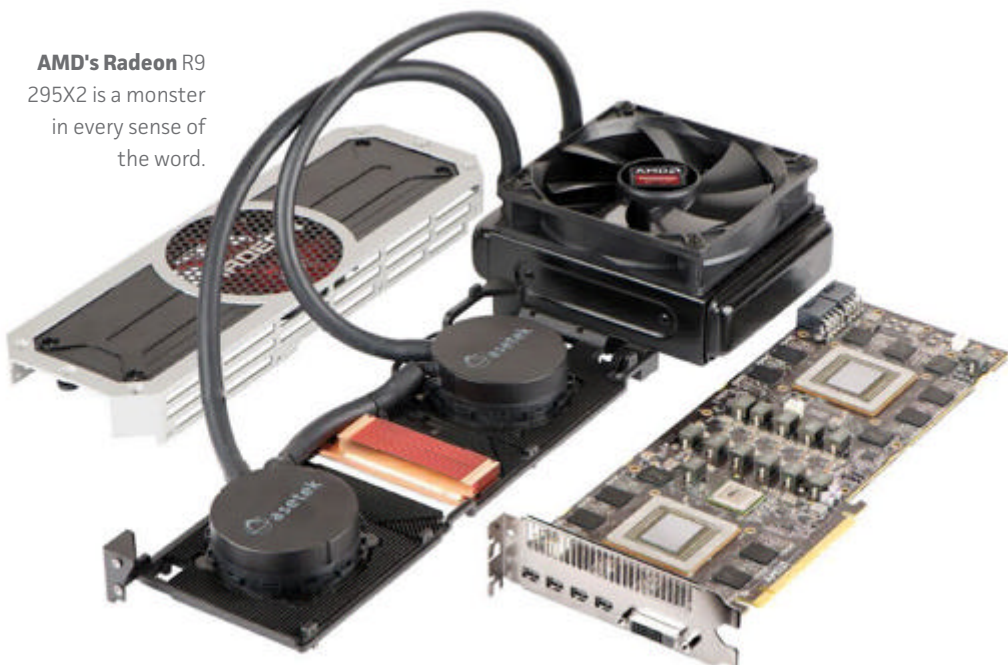
to do with *Civilization: Beyond Earth*.

There are some crucial gotchas: Only a handful of games support Mantle, and the most mind-blowing performance increases typically come when you're using a low-end processor or APU. What's more, it remains to be seen whether Mantle will continue gaining traction once the very similar DirectX 12 ships with Windows 10 later this year, as it supports all major hardware configurations—not just Radeons.

Until AMD launches its next-gen graphics hardware to counter Nvidia's Maxwell-powered GeForce 900-series GPUs, the Radeon cards' true strength lies in their price-to-performance ratio. AMD has long been the favorite for price-conscious gamers, and steep price cuts in the wake of the GTX 970 and 980's launch have only driven that home. You can more often than not find the flagship Radeon R9 290X selling for right around \$300 these days, and that's with a fancy aftermarket cooler.

AMD's Radeon R9

295X2 is a monster
in every sense of
the word.



The Nvidia GeForce GTX

970 is great graphics card despite its funky memory allocation design.



So which graphics card should you buy?

So, which graphics card within my budget gives me the best bang for my buck? Glad you asked!

\$100: If you're looking to spend \$100 or less, the AMD Radeon R7 (go.pcworld.com/radr7) 250X is your best choice. It's no barn-burner, but it will let you play modern games at 1080p on low to medium detail settings.

Under \$200: The Radeon R9 270X (go.pcworld.com/radr9) is a solid choice, especially if you can find one on sale around \$150. However, you'll need to dial down some detail and anti-aliasing settings in especially demanding games.

But it's worth giving the Nvidia GeForce GTX 750 Ti (go.pcworld.com/gtx750ti) honorable mention here, because it doesn't need any supplementary power connections whatsoever. That, plus its humble 300W power supply requirement, means the GTX 750 Ti could add a big graphics punch to a low-end system with integrated graphics for just \$120.

\$200: The GTX 960 (go.pcworld.com/gtx960) is clearly the best pick of the cards we've tested, delivering very playable frame rates with high or ultra settings at 1080p resolution. Its silence, coolness, and power efficiency are top-notch, too. But note that while we haven't been able to test its Radeon counterpart directly—the R9 285, other sites report that AMD's card offers similar performance, albeit in more power-hungry fashion.

\$250: The Radeon R9 290 (go.pcworld.com/radr9) can't be beat here. This high-end card was selling for \$400 less than six months ago. Insane!


But its pricing has started creeping upwards again recently. The Radeon R9 280X delivers an awful lot of bang for your buck in the \$200 to \$250 range, if the R9 290 is currently selling outside of your price range.

\$300–\$500: Nvidia's GeForce GTX 970 (go.pcworld.com/gtx970) is a beast at \$330, despite the firestorm over its memory allocation design and incorrect initial specs. The card bests AMD's flagship R9 290X in our trio of games at both 1920x1080 and 2560x1600 resolution, has plenty of overclocking overhead if you want to push it further, sips power, and runs far cooler than AMD's graphics cards.

If you plan to game on multiple monitors or on a 4K monitor, the Radeon R9 290X's memory configuration pushes insane amounts of pixel. If you're gaming on a single non-4K monitor, opting for a \$300 Radeon R9 290X over a \$330-and-up GTX 970 could save you real dough with minimal per-formance impact—assuming you can find one of those \$300 deals, that is.

\$500 and up: The \$550 GeForce GTX 980 (go.pcworld.com/gtx980) is the most potent single-GPU graphics card on the market today. Its insane power efficiency is the icing on the cake.

The dual-GPU champion: Finally, the \$700 Radeon R9 295X2 (go.pcworld.com/radeonr9295x2) is in a league of its own with a pair of graphics processors crammed into a single card. If you can afford the sticker price and the sky-high power usage, this behemoth demolishes any single-GPU graphics card you can buy. With prices hovering around \$695, it now sells for less than half of its original \$1550 sticker price.

However, you could buy a pair of Nvidia GTX 970s and run them in SLI for roughly the same price and performance. But you'd lose the Radeon R9 295X2's single-card form factor, kick-ass integrated water cooling, and—most notably—AMD's memory configuration, which as I said earlier, is better built for pushing anti-aliasing settings while gaming at ultra-high-resolutions when compared to the GTX 970's odd memory design. 

...the \$700 Radeon R9 295X2 is in a league of its own with a pair of graphics processors crammed into a single card.

Remaster brings Grim Fandango back to life

BY HAYDEN DINGMAN

OKAY, YOU'VE HEARD of this “*Grim Fandango*” game for years and everyone seems pretty excited it’s been re-released, but what is it? Any relation to the WWE wrestler? How about the excellent-but-also-underrated and canceled cartoon *Frisky Dingo*?

No and no. Unfortunately.

Grim Fandango is a classic adventure game from Tim Schafer and company released right before LucasArts stopped making classic adventure games. In other words, the long-distant past of 1998.

You play the part of Manuel “Manny” Calavera, who looks a lot like the Grim Reaper until he takes off his cloak and takes off his stilts and



folds up his scythe and reveals he's...a travel agent. No, seriously. When you die, you end up in the Land of the Dead where you must embark on a four-year journey to the Ninth Underworld.

If you were a good person, however, you can skip that whole “four-year journey” thing and travel in style—by car, by boat, or by the fabled “Number Nine” train, which can get you to the Ninth Underworld in mere minutes. Manny’s job is to sell these travel packages.

There’s a huge conspiracy afoot in the Land of the Dead though, and it’s up to Manny to solve it. Someone is stealing Number Nine tickets from good people and leaving them to the four-year walk. And when it happens to one of Manny’s clients, well, that’s when things get interesting.

It’s a seedy noir film mixed in with Aztec-Mexican views of the afterlife. Frankly, it’s one of the most unique and clever settings ever to make it into a video game, and shows off Tim Schafer and LucasArts at their prime.

The game also sold terribly, so it’s unlikely you’ve played it, unless you donned an eye-patch in the



Grim Fandango Remastered

PROS:

- One of the most creative, best-written video games of all time
- New control schemes are spiffy

CONS:

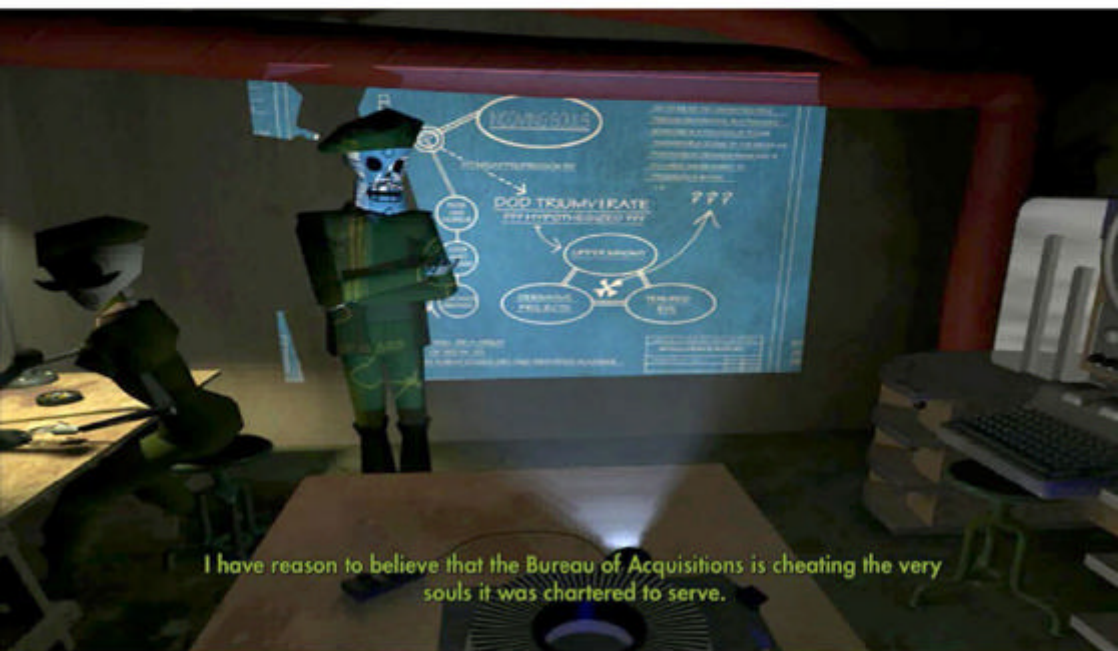
- Some of the puzzles are inane
- Occasional graphical glitches or ugly textures

BOTTOM LINE:

Nearly impossible to purchase for over a decade, you can now play *Grim Fandango* and understand why it’s one of the best adventure games ever made.

\$15





last fifteen years. You should play *Grim Fandango Remastered* (grimremastered.com). It's great.

Some caveats: It's a 90s adventure game, meaning it is full of asinine puzzles where the solutions barely make sense. If you haven't played before, you're going to get stuck. Just do yourself a favor: Open a walkthrough, read the solution, say "Wow, that's stupid," move on, and continue enjoying the game's excellent writing. Don't let the game ruin your enjoyment of the game. Because it could. Really easily.

Seriously, and I can't say this enough, some of the puzzles are absurd. Here's an example: There are beavers that are on fire and you have to lure them to jump off a cliff and shoot them with a fire extinguisher so they drown in a tar river. Is that inane enough? Because I almost had an aneurysm typing it.

Now with that out of the way, let's talk about the "remastered" part of *Grim Fandango Remastered*.

Skuldullery is afoot and it's affecting Manny's clients.

Graphics

This is *Grim Fandango Remastered*, meaning it's basically a prettied-up version of *Grim Fandango*. Don't go into this expecting as extensive a remake as, say, *Gabriel Knight: Sins of the Fathers*.

Instead we get *Grim Fandango* but smoothed out a bit for modern high-resolution monitors—smoother edges on 3D objects, for instance. At times it's stunningly gorgeous and there's almost a claymation feel to certain scenes.

Other times, a bad model or awkward shading reminds you that this is a game from 1998. Your pal Glottis is the worst of the lot, with weird bulgy arm muscles that tend to clip through each other. The 2D backgrounds also could use work. Most have clearly just been resized to fit the higher resolutions, resulting in grainy and blurry backdrops that look entirely out of place compared to the smooth character models.

As for accommodating modern monitors, you can play the game in 4:3 (native), 4:3 with some vaguely Aztec or Art Deco-inspired borders on the left and right, or in 16:9 stretched. I played in the latter because I hate borders, but the obvious drawback is that “skeletal” Manny Calavera looks pretty fat, like he's the skeleton of a retired football player.



Glottis' weird
bulgy arm
muscles tend to
clip through
each other.

Controls

The graphics overhaul on *Grim Fandango* is spiffy, but people who played the original will probably be most excited about the new controls. Like *Resident Evil* (and some other early 3D games), *Grim Fandango* was all about tank controls. It's a control scheme that makes sense because you're dealing with constantly-changing camera angles, so camera-relative controls are a bit awkward.

But that didn't really explain why you couldn't just play *Grim*



Fandango the way everyone expected, in other words, as a point-and-click adventure game.

Now you can! The whole game is controllable with the mouse and keyboard, without mods. Or you can play with just the keyboard. Or you can bust out the gamepad and play with either tank or camera-relative controls. There are so many options!

None of them are perfect. The mouse is great for highlighting interactive objects in a scene. However, the problem with the mouse is boredom. A lot of areas were clearly designed with the idea that you were directly controlling Manny. Watching him run across six empty screens in a row is pretty tedious.

Keyboard controls are pretty mediocre, but they'll suffice if you don't have a gamepad or if you just love tank controls.

My trusty 360 controller was a decent experience, but the game won't highlight interactive objects—instead you'll have to pay attention to which way Manny is looking. Also, some of the camera angles are designed with mouse-keyboard precision in mind, and you can trigger doors by just walking into them (which is a huge pain if you're trying to, for instance, exit an elevator and accidentally trigger it again).

There's almost
a claymation feel
to certain scenes

I ended up playing with some sort of hybrid mouse-gamepad controls, which ultimately suited my needs fine. Then again, that's why we're PC gamers right? Plenty of possibilities and personal customization.

You could always play the whole game with tank controls and score the sweet "The Right Way" achievement. (The accompanying text says "Tim [Schafer] demanded this achievement.")

Bottom line

Grim Fandango Remastered isn't perfect. We've had prettier—or at least more extensive—overhauls of some classic adventure games recently, including *Gabriel Knight: Sins of the Fathers* and *Shadowgate* (and *Resident Evil HD* since that's kind of an adventure game).

On the other hand, it's [expletive] *Grim Fandango*—a game that's been all-but-unobtainable for over a decade—cleaned up to run on modern systems and it looks astonishingly good for its age.

Is it a 90s adventure game full of adventure game logic? Absolutely. Are the graphics and controls perfect? No. Could it use a bit more polish? Probably.

But the writing is hilarious, the characters and setting are creative as hell, and along with *The Longest Journey* I'd say *Grim Fandango* exemplifies classic adventure games. It's ambitious and mature in a way that not a lot of games before or since have accomplished.

Longtime fans? Snag a copy. People who missed the game the first time around but have heard for years how great it is? We weren't lying—snag a copy and play it with a walkthrough, if that's what it takes. There's no excuse now. 🕹️



Is it a 90s adventure game full of adventure game logic? Absolutely.



QNAP HS-251 : NAS meets home entertainment

BY JON L. JACOBI

NETWORK ATTACHED STORAGE (NAS) is probably not the first thing you think about when you consider your home-entertainment system, but at least one company intends to change that: QNAP. They have offered HDMI output and a 10-foot user interface (so you can operate it from the comfort of your couch) for a year or two on their mainstream NAS boxes. Now it's added quiet operation and style to attract less-technical users. It has mostly succeeded in that effort.

Where the average NAS box is rather unhandsome and stands upright, the HS-251 (go.pcworld.com/qnaphs251) is sleek and horizontally oriented. It houses two 3.5-inch drive bays that lay flat and side by side, with metal drive trays that come in contact with the metal part of the case to act as heat sinks and are accessed via a black magnetic panel that pops off the front. The whole effect of the 1.5-inch high by 12-inch wide by 8.75-inch deep unit is something akin to a modern set-top box. And, there are no fans whirring to distract you from the latest Hollywood epic.

This isn't your IT department's NAS box

The HS-251's real value lies in its QTS 4.1 operating system and apps. It's a custom version of Linux with nearly every capability that has been developed for platform. The short list of multimedia-related features includes media streaming from DLNA and iTunes servers; the XBMC 10-foot interface for live TV as well as photo and video streaming; a built-in BitTorrent client; real-time or offline media transcoding of nearly any video format; support for 4K video resolution; and access to online video services such as YouTube.

QNAP provides a framework called HD Station (the acronym stands for HybridDesk, not High-Def) that is accessed when you

The HS-251's real value lies in its QTS 4.1 operating system and apps.

QNAP HS-251

PROS:

- Fast and quiet, great with multimedia, looks good in the entertainment center.

CONS:

- Needs work to be multimedia-ready out of the box.

BOTTOM LINE:

This network-attached storage box is a less-expensive alternative to a full-blown home-theater PC, and it can do a whole lot more than just stream media to your TV.

\$400



have a display attached directly to the HDMI port. That's where you'll find XBMC, the 10n-foot interface that provides video, music, and photo playback capabilities mimicking those found in consumer video equipment. But first you have to set everything up via the Web interface (and that's not for everyone), enable HD Station, download the apps, and so on. It's not dead simple.

The HS-251 ships without drives, so you'll need to decide what to put inside it. I've run the HS-210, the HS-251's

nearly identical predecessor, with 3.5-inch hard drives, 2.5-inch hard drives, and 2.5-inch SSDs. SSDs are obviously the fastest solution, but read speed isn't all that important when you're streaming music and video. Hard drives are slower, but they deliver a lot more capacity for the money. If you go that route, I highly recommend using 2.5-inch drives. They run cooler, and in most instances, they're considerably quieter.

The HS-251 has much more in common with QNAP's high-end consumer boxes than the cheaper HS-210. First there's the array of ports: dual-Ethernet jacks supporting ganging and failover, two USB 2.0 ports for peripherals, two USB 3.0 ports for storage (or an 802.11ac Wi-Fi adapter), and an HDMI port.

There's a second port with the HDMI form factor, but there's a cap on it that says it's reserved. Here's hoping it eventually will allow HDMI input, so you can record from external video

If you're familiar
with NAS boxes, you
probably pictured
something like
QNAP's TurboNAS
TS-251.



equipment. At the moment, the HS-251 lacks that capability. Note that you can attach a USB W-Fi adapter to render the HS-251 wireless, and you can plug in a USB TV tuner for live TV.



A very fast box

The HS-251 is quite fast thanks to its Intel Celeron J1800 processor and 1GB of onboard memory, which is great for transcoding video (most consumer NAS boxes use weaker ARM or Intel Atom CPUs). QNAP also offers a 2G model that comes with—you guessed it—2GB of system memory. To avoid a mechanical hard drive being a bottleneck, I tested the box with a single 240GB SanDisk Extreme II SSD installed.

CrystalDiskMark rated the HS-251 as reading files at about 90MBps and writing them at about 107MBps. In my own tests with a 20GB set of files and folders, I got around 60MBps both ways. With a single large 20GB file: 99MBps reading and 109MBps reading. Not bad at all. A superfast OCZ Revo PCIe SSD driven by an Intel Core i7-3770 was on the other end of the gigabit connection.

Beyond multimedia, or actually behind it in NAS's more traditional role as a business server, the HS-251 can act as a Web and mail server, provide content management services, and act as a backup repository and file server. It also provides clients that keep the entire box backed up online to cloud-storage services such as Amazon S3, Elephant Drive, Google Drive, and others.

Additionally, it can serve up your own personal cloud, either directly from the box using its integrated (and spectacular) Web interface or via QNAP's myQNAPcloud Web portal service. It syncs with online storage services such as Azure, Google Drive and Dropbox to keep itself backed up. Then there's SSDP (Simple Device Discovery

The QNAP HS-251 looks more like a DVR or set-top box than a network-attached storage device.

Protocol) and OpenRemote for hardcore connected-home aficionados.

You even get a surveillance app that supports licenses for two IP cameras, and you can access everything from any web browser or Android and iOS app. And as I mentioned up before, this box will also output directly to your HDTV or monitor via HDMI. If you need all that, this is one handy product.

Hands-on time

Then there's a bit of what many might consider extraneous "computer" stuff such as IP addresses on the main screen, and the interface. While not ugly, it isn't the slickest I've seen. Also, the apps are from different sources, and their interfaces vary quite a bit. Some require you to log on; that is, enter your user name and password. None of this is difficult if you understand computers, but it's nowhere near as easy to use as a smart TV. And I've seen users struggle with smart TVs.

QNAP sells a remote that you can use to navigate the interface, but you can also use a mouse and keyboard, including wireless types via a USB or Bluetooth dongle. (There are plenty of available ports.) I actually prefer the mouse and keyboard for entering passwords, browsing the Web, searching YouTube, and whatnot. Remote-control cursoring and selecting letters one-by-one is not my bag.

The HS-251 costs \$400 without storage, which puts it at the high-end of the two-bay consumer NAS market. But it's fast and quiet, great with multimedia, and looks good in the entertainment center. I can readily recommend it to anyone who wants to merge their home networking and online multimedia with their home theater. On the other hand, QNAP still has some work to do in making it multimedia ready out of the box, so it's currently for only the more adventurous user. 🍷



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Join The Nature Conservancy to plant a billion trees,
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at plantabillion.org

The Nature
Conservancy 
Protecting nature. Preserving life.™

A CLOSER
LOOK AT
BATTERY
LIFE 

DELL

XPS 13

VS

MACBOOK

Air

BY GORDON MAH UNG





he MacBook Air's battery life is legendary. Colleagues who drive MacBook Airs claim they can get all-day battery life, and that no similarly sized PC can do the same. But now we have a real contender: The Dell XPS 13 (go.pcworld.com/dellxps). Time to test those claims.

Before we dig in, it's important to note that there's no single test that can compare PC and MacBook battery life directly. We have to arrive at comparable numbers through reasoned use of similar tests. I'll also be discussing other reviewers' tests to help paint a more detailed picture.

Other outlets have actually expressed disappointment with the XPS 13's run time. Jason Evangelho of *Forbes* said (go.pcworld.com/je): "Dell's battery life claims miss the mark by a not-insignificant amount, and the XPS 13 still can't match or exceed the Air in that department. I was desperately hoping it would. But is it poor battery life? Absolutely

not.”

Here’s an important detail, though: Evangelho’s comparison was with a MacBook Air 13, which has a larger battery than the MacBook Air 11. He’s also planning to retest after disabling Windows Indexing and seeing the Dell’s life shoot from 7.5 hours to 9.5 hours.

Over at *Gizmodo*, Sean Hollister was also deeply disappointed (go.pcworld.com/sh): “Dell quotes up to 15 hours of battery life, and I struggled to get even half

that in the real world.” But he, too, tested the XPS 13 against the MacBook Air 13. Hollister tested the QHD+ version and the 1080p version of the XPS 13, getting 5 hours and 6 hours respectively, while the MacBook Air 13 gave him 8.5 hours of practical use.

WE THINK DIFFERENTLY

Here’s where my tests will differ. In my view, the MacBook Air 13 is quite a bit larger than XPS 13, despite the XPS 13’s similarly sized panel. The fairer comparison to the XPS 13 2015 should be based on size. So I reached into our locker for a MacBook Air 11 2014. That model is just slightly smaller than the XPS 13.

That’s also where you’ll see some pretty big differences in specs. While the CPU and storage options don’t change, Apple takes advantage of the Air 13’s larger chassis to pump up the battery capacity. The MacBook Air 11’s battery is 38 watt hours. The MacBook



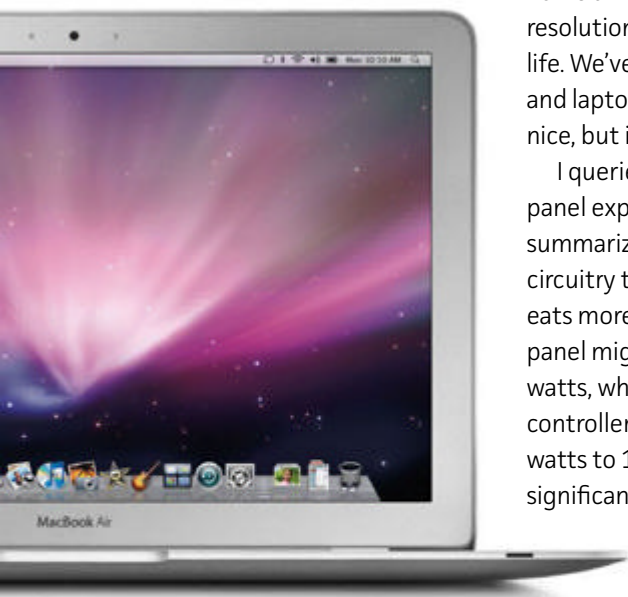
The XPS 13 can out perform the MacBook Air in battery life even with its high resolution screen.

Air 13's is a massive 54 watt hours. That's about a 40 percent increase in battery capacity over the MacBook Air 11, and a little better than the Dell XPS 13's 52-watt-hour battery.

I'll also point out that both Dells pack far more pixels than the competition. The top-end XPS 13, with its QHD+ screen, has a resolution of 3200x1800. The base model's is 1920x1080. The MacBook Air 11 is 1366x768, while the 13-inch model is 1440x900.

Thinking about resolution in megapixels helps illustrate the scale of the difference. The 11-inch MacBook Air is 1MP (1 million pixels). The 13-inch model is 1.3MP, and the 1080p XPS 13 is 2MP. The high-res Dell XPS 13 is...wait for it: 5.7MP.

MORE PIXELS USE MORE POWER



The MacBook Air 11 is slightly smaller than the XPS 13 and also has 1/5 its pixels too.

As we all know, an increase in resolution can impact battery life. We've seen it in phones and laptops. Pixel density is nice, but it isn't free.

I queried Dell's laptop panel expert, who summarized it this way: The circuitry to drive the panel eats more power. A 1080p panel might consume 0.9 watts, while a 4K panel controller might use 1.3 watts to 1.5 watts. That's significant when you consider that the monitor generally consumes the

most power on a laptop today.

Then there's also the power needed to light higher-dpi panels. Because the

pixel pitch is much tighter, it blocks more light. That means it takes more light to get to the same brightness level of a lower-resolution screen.

One way to get around that is to use different screen technology. IGZO panels, for example, let more light through than a traditional high-res IPS panel, so you don't have to burn as much power to hit the same lighting levels.

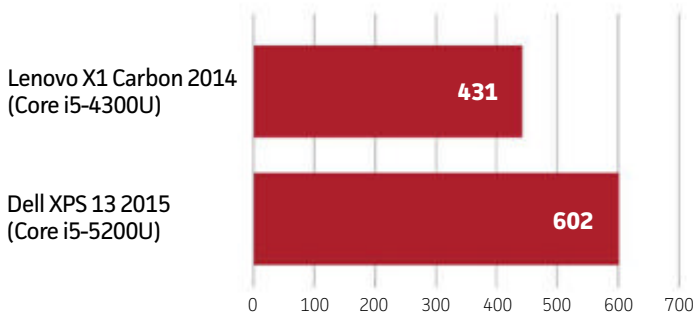
It's a trick Lenovo/NEC is taking with its LaVie to cut the weight to 1.76 lbs. By using an IGZO panel, Lenovo can reduce the battery size while maintaining acceptable brightness and run time.

BATTERY TESTS

In my XPS 13 review, I used BAPCo's MobileMark 2014 test. It's the updated version of the industry-standard MobileMark 2012. It uses off-the-shelf and popular applications, and it runs them through various tasks at normal speeds.

MobileMark is unlike most rundown tests in that it acknowledges typical users' tendencies to take breaks or zone out like Office Space's Peter Gibbons. MobileMark replicates this by allowing long pauses and letting the screen go to black.

MOBILEMARK 2014 OFFICE BATTERY LIFE (MIN)



LONGER BARS INDICATE BETTER PERFORMANCE

MobileMark 14 is perhaps the most realistic test for measuring actual office productivity battery life around and the Broadwell chip delivers in battery life. Keep in mind, the XPS 13 also has a larger battery too.

The above test shows the battery life performance of the XPS 13 with QHD+ screen against the larger and older Lenovo X1 Carbon 2014. Despite its higher-resolution screen, that's decent battery life in the Dell. The X1 Carbon is a different beast: It has a 14-inch screen and a 45-watt-hour battery. Keep in mind, that's with the Wi-Fi hot (but connected to a router that goes nowhere), which is required by MobileMark 2014.



The XPS 13 on top of the MacBook Air 13 shows the size difference and why I selected the MacBook Air 11 for my tests.

WHAT ABOUT THE MACBOOK AIR?

There is no MobileMark on the Mac that runs in OS X. Yes, I could install Windows 8.1 and dual-boot, but I'm not sure that accomplishes much. I'm also not sure how much actual optimization Apple does for Windows. I suspect the company would rather have its users boot into OS X and run Windows apps in Parallels.

Is there really a cross-platform battery test that makes sense? I'm investigating, but for now I decided to do video run-down test. It's something everyone can agree is a fair usage scenario.

Apple rates the 11-inch MacBook Air for 9 hours of browsing and 8 hours of video runtime. The 13-inch model, with the 40 percent larger battery, gets you to 12 hours of browsing, 12 hours of movies.

Dell rates the QHD+ version of the XPS 13 for 11 hours of browsing and 8 hours of HD video playback. The 1080p version of the XPS 13 takes it to 15 hours of browsing and just under 13 hours of video.

Each company uses its own battery methodology that can't be directly compared. Even the "browsing" tasks are different: Apple uses iTunes to play a 720p video, while Dell uses Microsoft's standardized Windows Assessment & Deployment Kit, which uses an H.264 file to gauge battery life in Windows-based devices. With two different video files and two different video players, it's like comparing oranges and bricks.



HOW I TESTED

To make it as even as possible, so I grabbed VLC 2.1.5 for OS X and Windows and used the 1080p *Big Buck Bunny* .OGG file PCWorld has. You should know that using VLC on Windows hardly favors the platform—in fact, it's downright mediocre in optimization. Tim Schiesser over at *TechSpot* has done some great testing on this front (go.pcworld.com/ts), and other individuals have validated his findings. For my tests, I disabled hardware acceleration in VLC on both platforms, as I saw screen corruption when I enabled it under OS X.

I disabled variable screen brightness on both platforms and set the brightness to as close to 190 nits as I could on all three laptops. The QHD+ was actually putting out closer to 200 nits. I used our Minolta Photometer to measure the laptops' display brightness at dead center.

If you're setting the laptops based on the percentage of slider controls, you should know that doesn't mean much. Setting the MacBook Air 11 to 50-percent brightness is about 64 nits, while the same middle of the slider setting on the XPS 13 QHD+ is 185 nits. That's a huge difference.

So as not to annoy my office mates, I ran our tests with volume muted, which isn't realistic, but at least the audio was not a factor. Since I wrote my original review, I also was able to obtain the 1080p version of the XPS 13 that has 4GB of DDR3L/1600. My results are in minutes and were manually recorded by having all three laptops sitting

VLC is popular

because it'll play just about any file format in the universe and it runs on OS X and Windows.

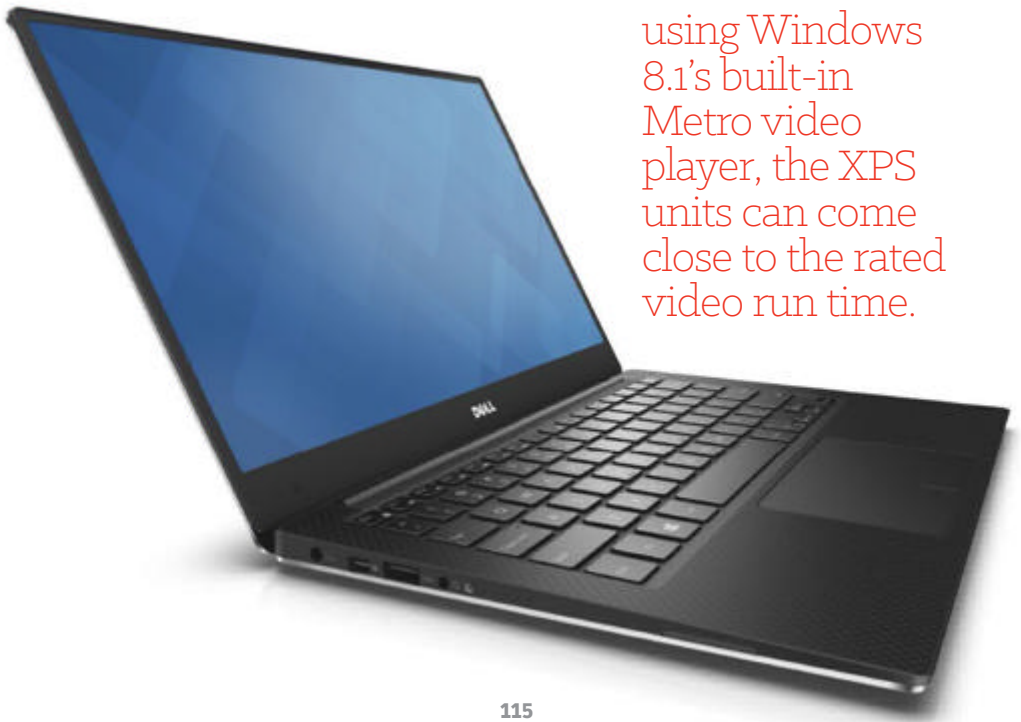
on my desk and noting the time when the screens finally went to black. Wi-Fi was hot on all three, but the connected router went nowhere, so there was no chance of their downloading updates in the background.

Using VLC and the 1080p .ogg file, I saw about five hours on the QHD+ XPS 13, another half-hour or so on the MacBook Air 11, and just over seven hours on the 1080p version of the XPS 13. It's pretty clear that with a lower-resolution file and using Windows 8.1's built-in Metro video player, the XPS units can come close to the rated video run time. There should also be a healthy bump up in run time for the MacBook Air using iTunes.

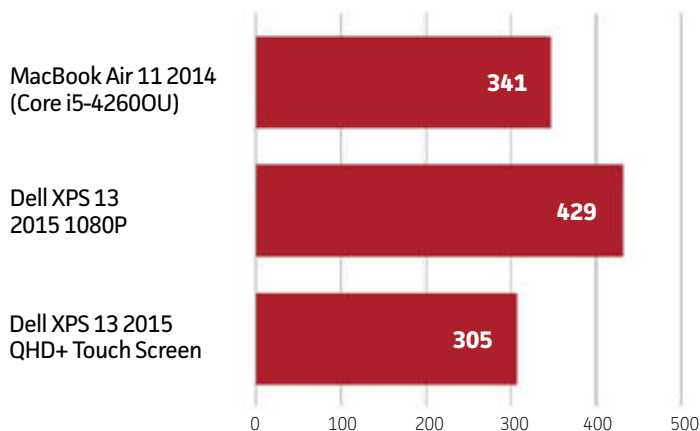
So the MacBook Air 11 is better in run time, right? Sometimes. When I ran my original review, I actually didn't use the shorter .ogg file. I used our encoding test file: a 31GB MKV file that's high bit-rate and 1080p.

That file is a bear, and we can see all the laptops

It's pretty clear that with a lower-resolution file and using Windows 8.1's built-in Metro video player, the XPS units can come close to the rated video run time.



OOG FILE LOOPED



LONGER BARS INDICATE BETTER PERFORMANCE

taking a far bigger hit in battery life—including the MacBook Air 11, which suddenly falls behind the XPS 13 QHD+. This could be because the Haswell CPU in the MacBook Air 11 worked harder to decode the file than the Broadwell CPU in the XPS 13, or possibly something to do with the M.2 drive in the MacBook Air, which is PCIe-based and far faster than the M.2 SATA in the Dells.

NO ONE GETS BRAGGING RIGHTS

After trying to wrangle cross-platform battery testing and seeing how many variables can go into the tests, I've decided that the best we can say is battery life on X platform is better for Y task. So, I can say quite comfortably that playing 1080p MKV files using VLC, the XPS 13 gives you better battery life.

I also believe that unless you're saying what exactly you're testing and how you're testing it, it's not very easy to compare the two platforms on pure battery life. I also don't think it's valid to try to compare platform Y against platform X by seat-of-the-pants testing of

MKV FILE LOOPED

MacBook Air 11 2014
(Core i5-4260OU)

224

Dell XPS 13
2015 1080P

360

Dell XPS 13 2015
QHD+ Touch Screen

260

0 100 200 300 400

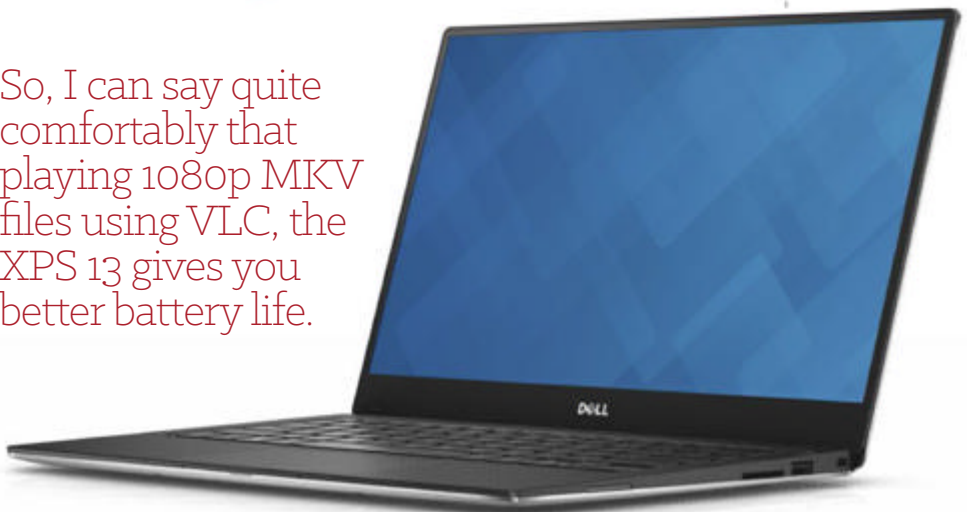
LONGER BARS INDICATE BETTER PERFORMANCE

Using a higher
bit rate MKV file,
the MacBook Air
11 loses to both
XPS 13 units.

“using it”. That’s just too hard to replicate in a manner that’s actually useful beyond trolling each other in a forum.

Maybe the best way to settle this discussion next time is to say your mileage may vary. 🖱️

So, I can say quite comfortably that playing 1080p MKV files using VLC, the XPS 13 gives you better battery life.





Troubleshooting **Google** **Hangouts** and **ooVoo**

Plagued by alert overloads, invasive ads and worse during important online meetings? We are. **Christopher Null** tackles our 10 biggest complaints.



Hangouts doesn't work in Internet Explorer from the Windows 8 Start screen

If you run Hangouts on multiple devices, Hangouts sends notifications to everything that's running, causing alert overload

Photos sent via Hangouts over MMS taken in portrait mode automatically rotate and turn into landscape photos

Video calls don't work

The Hangouts Browser plug-in won't install (or disappears)



My camera isn't working at all

Audio isn't working

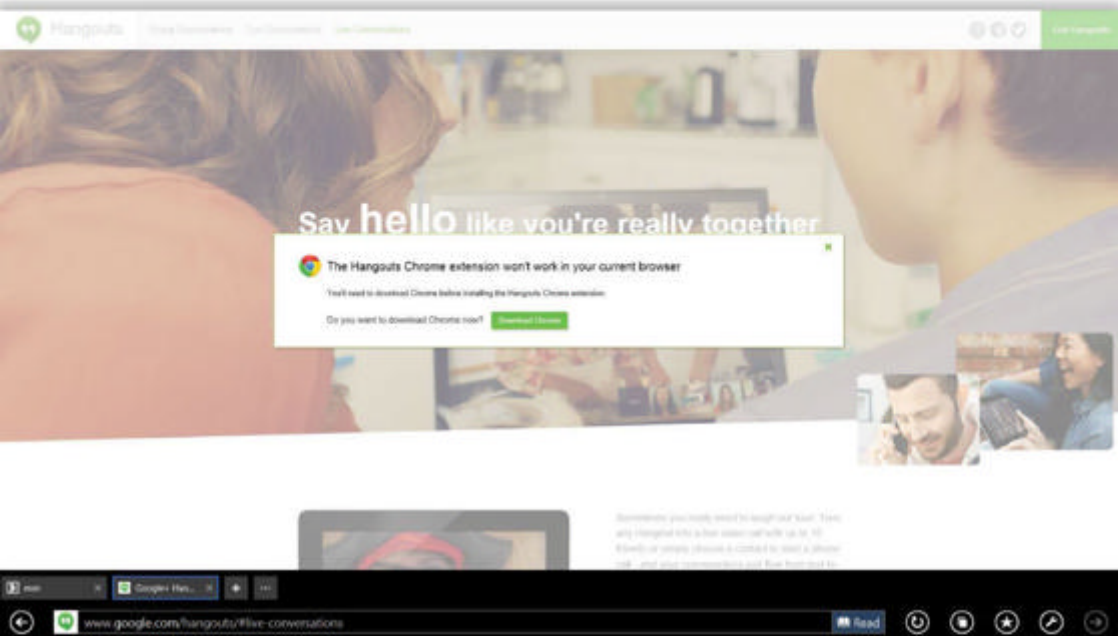
Contacts aren't showing, or the screen is white, when I log in through Facebook

Video calls are not connecting, or the system is frozen with a notification reading "Connecting..."

Video quality is low, pixelated, or freezes during sessions

We feel our readers' pain around glitchy online communication. For several years PCWorld's editors have tried and largely failed to use **Google Hangouts** for staff meetings with remote users. Just when we think we've figured out all the kinks, something else goes wrong. Then there's the free **ooVoo** video call app. Sadly the invasive advertising overlays are unavoidable until you click the little Xs, but other annoyances can be fixed.

For ten notable video and voice headaches relief is only a page away.



5 TIPS FOR GOOGLE HANGOUTS

1. Hangouts doesn't work in Internet Explorer from the Windows 8 Start screen.

If you're using the Start screen to launch Internet Explorer, you may find that Hangouts doesn't work. That's because Hangouts requires a plug-in to operate on IE, and the full-screen, Metro-style version of IE doesn't allow any plug-ins. To work

around this, you have a couple of choices. You can run IE in Desktop mode by launching it from the desktop instead of the Start screen, and then install Hangouts, or you can switch to another browser.

Sorry, Metro fans!

Launch your browser from the Windows desktop in order to use Chrome.

2. Hangouts sends notifications to everything that's running, causing alert overload.

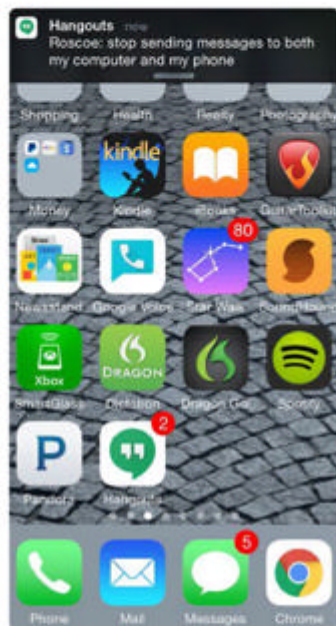
If you have Hangouts open on your desktop and your phone simultaneously, notifications will pop up on both devices, even if you

aren't actively engaged with one of them.

This is unfortunately a known issue with Hangouts. It's a pain for some users, while other users actually prefer it to work this way.

If you're getting too many notifications, a few solutions are available. First, you can sign out of Hangouts on devices or browsers from which you don't want notifications, or close the app altogether.

On Android devices, you have a few more options. You can use *Menu > Snooze* notifications to suspend alerts on that device. Notifications can also be suspended indefinitely on a per-user basis by selecting the gear icon in a Hangout window and unchecking the Notifications box there.



Stem the flood of notifications by closing the Hangouts app or signing out.

3. Photos sent via Hangouts over MMS taken in portrait mode automatically rotate and turn into landscape photos.

This is a specific issue related to Hangouts on certain Android phones when pictures are sent over MMS. Many users report that the problem is erratic and that clearing application data from the Android Applications Manager may help, at least some of the time.

The more reliable solution is not to use the camera within Hangouts to snap photos, but to take pictures separately, using the standard Android camera. When portrait photos are attached



from your photo library, they seem to come through with the proper rotation intact.

4. Video calls don't work

There are many potential reasons that Hangouts won't initiate a video call, here are the most common troubleshooting tips.

First, the Chrome browser doesn't require a plug-in for Hangouts to work... unless your company uses Google Apps, in which case you will still have to install the Hangouts plug-in (go.pcworld.com/plug) to make video calls. It's also a good idea to install the Hangouts Chrome app (go.pcworld.com/capp), which adds Hangouts to the Chrome App Launcher, where you can initiate a new video call.

Note that Hangouts does not support (go.pcworld.com/nosup) a handful of webcams, microphones, and audio devices. Presuming this is not your issue, make sure the correct audio gear is selected within Hangout's settings menu. To find this menu, initiate a new video, then click the gear icon. Hangouts may work better if you select specific devices for each of the three options instead of "Default".

Finally, in general, restarting your browser and/or your computer is also a good cure-all for any video-related problem within Hangouts.

Google Hangouts works on many devices, but individual troubleshooting may be required.

5. The Hangouts Browser plug-in won't install (or disappears)

Can't install the Hangouts plug-in? First, make sure you aren't running 64-bit Internet Explorer, as the plug-in is not supported on this browser. If you're using Chrome, check <chrome://plugins/> to see if the Google Talk

plug-in is installed and enabled. (The name is a remnant of Hangouts' prior incarnation.)

You can also try uninstalling this plug-in (instructions can be found at go.pcworld.com/uninstallg) and reinstalling it.

Remember that the Hangouts app is different from the Hangouts plug-in. (You don't need the former, but all browsers except Chrome require the latter.) If the Hangouts app has vanished from Chrome, simply re-enable it by re-downloading it from the Chrome Web Store.

If you're using Chrome, check `chrome://plugins/` to see if the Google Talk plug-in is installed and enabled.

The screenshot shows the Google Chrome Help page for "Plug-ins". The page header includes the Google logo, a search bar, and navigation links for "Chrome", "Help", and "Plug-ins". The main content area is titled "Plug-ins" and explains that plug-ins help the browser process special types of web content. It lists popular plug-ins for Windows, Mac, or Linux, including Adobe Flash Player, Adobe Reader, Java, Real Player, QuickTime, and Microsoft Silverlight. It also provides instructions for Windows 8 users and Chrome device users. A sidebar on the right lists various plug-ins, including Adobe Flash Player, Adobe PDF, Adobe Shockwave, DivX Plus Web Player, Java, Microsoft Silverlight, Native Client, QuickTime, and RealPlayer.

Google Search Chrome Help

Chrome > Help > Plug-ins

Plug-ins

Plug-ins help the browser process special types of web content, like Flash or Windows Media files.

Browser extensions are similar to plug-ins, but instead they add new features to your browser or modify the functionality of your favorite sites.

- On **Windows, Mac, or Linux?** Chrome supports most popular plug-ins:
 - Adobe Flash Player
 - Adobe Reader
 - Java
 - Real Player
 - QuickTime
 - Microsoft Silverlight

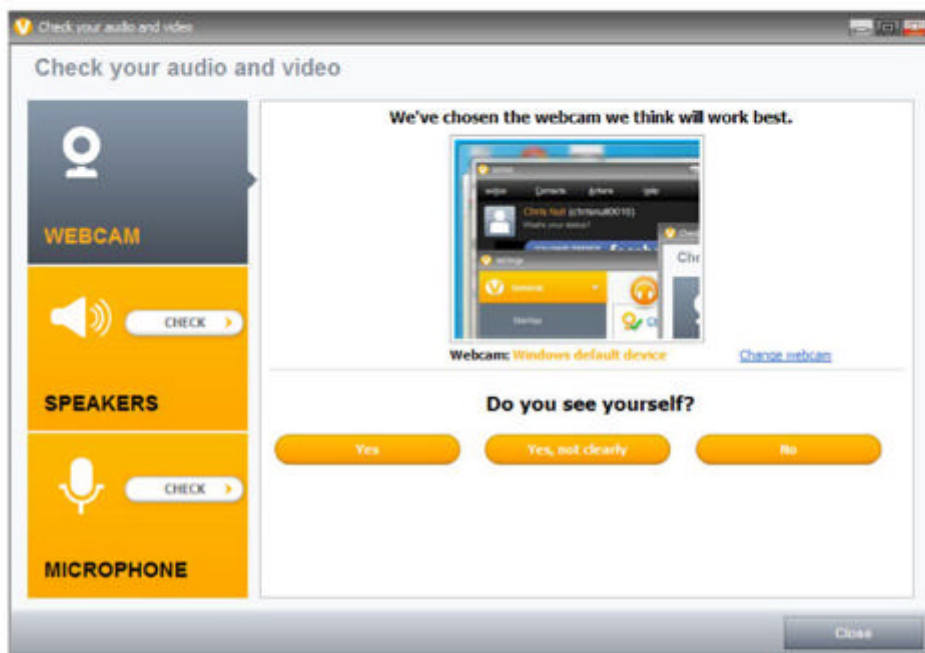
Windows 8 users: Due to system limitations, only plug-ins using Pepper API 6, such as Flash, Native Client, and Chrome PDF Viewer will function properly when Chrome runs as a Windows 8 app. [Learn more about plug-in in this browsing from Microsoft](#)

- On a **Chrome device?** Google Chrome supports [Adobe Flash Player](#), the [Google Talk plug-in](#), and [PDF](#).

- Install plug-ins
- Run or block plug-ins

Plug-ins

- Plug-ins
- Adobe Flash Player plug-in
- Adobe PDF plug-in
- Adobe Shockwave plug-in
- DivX Plus Web Player plug-in
- Java plug-in
- Microsoft Silverlight plug-in
- Native Client in Google Chrome
- QuickTime plug-in
- RealPlayer plug-in



Dumb down your video hardware to see put yourself in the picture.

5 TIPS FOR **OOVVOO**

1. My camera isn't working at all

Can't see anything? Try dumbing down your video hardware by clicking *ooVoo* > *Settings* > *Advanced* and deselecting *Use hardware acceleration*. If this option is grayed out, check your video card

drivers and see if an update is available.

As with other video conferencing systems, ensure you're using the correct camera. ooVoo buries this setting, which you'll find under *ooVoo* > *Settings* > *General* > *Audio & Video*.

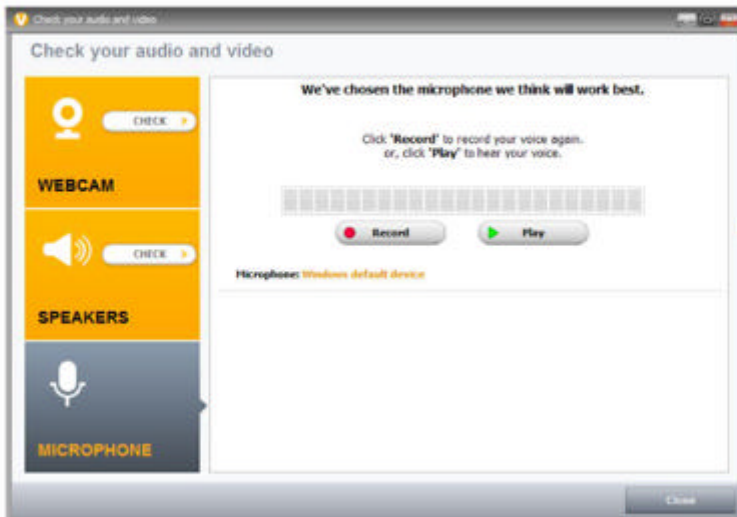
Click *Check your audio & video devices*, then click *Check* next to *Webcam*. ooVoo may select Windows default device, which may not be a webcam at all. On most laptops, Integrated Camera is what you want, which you can select under *Change Webcam*.

2. Audio isn't working

A whole host of problems can be responsible for ooVoo audio issues. Start by clicking to the *Check your audio & video devices* screen described in the previous tip. Check under *Microphone* to see if an existing microphone is active.

As well, run the record/play test here to ensure your microphone works. On mobile devices, try quitting other apps that might be using the microphone (and preventing ooVoo from using it in the process). No matter what device you're using, also ensure your microphone is not accidentally muted. There will be a red X over the microphone icon if it is.

Record some test audio and play it back to ensure ooVoo can see your mic.



The company's official advice is to reboot your device every day...

3. Contacts aren't showing, or the screen is white, when I log in through Facebook

This problem is primarily seen on mobile devices. To remedy it on iOS, visit your phone's Settings app, then

tap Facebook. Turn ooVoo on here. On an Android device, log in using Facebook from the ooVoo main screen and re-enter your Facebook credentials.

Ensure all permissions requested are authorized on the subsequent screen. If this doesn't work, try removing and reinstalling the ooVoo app, regardless of the device.

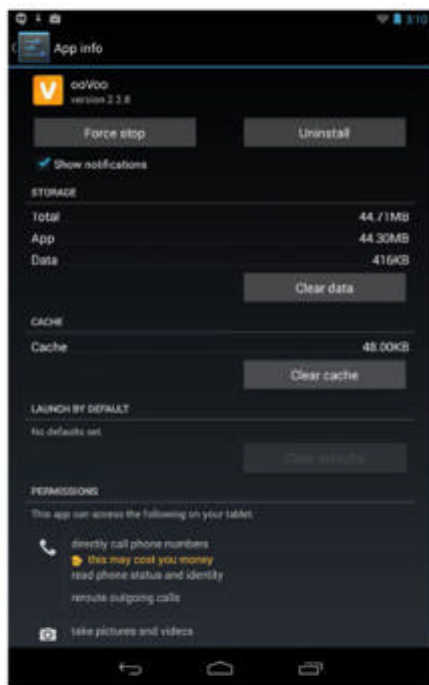
4. The system is frozen with a notification reading "Connecting..."

The company's official advice from ooVoo is to reboot your device every day (particularly for your mobile devices) to prevent this problem,

to close other apps, and to use Wi-Fi whenever possible.

Alternately, if you're using an Android device, try clearing all the settings. This can be found under *Settings* > *Apps* > *ooVoo*. Tap *Clear data* and relaunch the app.

On iOS, the best fix is to delete and reinstall the app.



Visit **Android's** settings to give ooVoo a fresh start.

5. Video quality is low, pixelated, or freezes during sessions

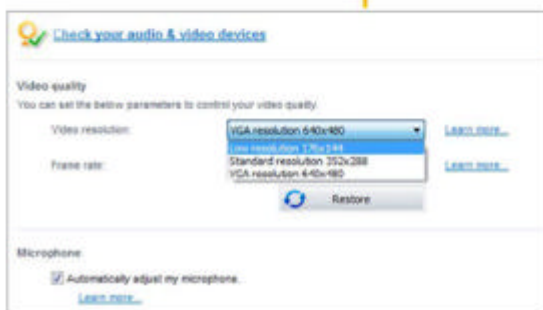
This can be a bandwidth problem, but ooVoo gives you significant control over its bandwidth consumption. If pixelation is a problem, click *ooVoo > Settings > Audio & Video* and click the *Video resolution drop-down*. VGA (640x480) is the default, but you can drop down to as low as 176x144 pixels.

You can also reduce the frame rate to as low as 5 frames per second. (15 is default.) As well, you can adjust quality settings if you're having these problems during a screen-sharing session by clicking *ooVoo > Settings > Video calls > Video call settings*.

The Screen sharing frame rate can be changed at the bottom of this screen. Note that you may need to end a call and reinitiate it for changes to go into effect. 🛑

Tweak the video

resolution and frame rate downward if pixelation is an ongoing problem



HELP KEEP THESE KIDS IN PLAY.

**175,000 KIDS WILL BE
DIAGNOSED WITH
CANCER THIS YEAR.**

Children are our greatest hope for the future.
Let's be their greatest hope too.

Cancer strikes infants and children. For teens
and young adults, survival can depend on
treatment by a pediatric oncologist, designed
specifically for them.

The St. Baldrick's Foundation and Stand Up To
Cancer are funding groundbreaking collaborative
research to bring the most effective therapies to kids
fighting cancer. To learn how you can help keep
these kids in play, go to stbaldricks.org/inplay and
standup2cancer.org/pediatrics.

Julia Hernandez
Diagnosed at 16,
in remission.

Samuel L. Jackson
Stand Up To Cancer and
St. Baldrick's Ambassador



**St. Baldrick's
FOUNDATION**
Conquer Childhood Cancer



St. Baldrick's Foundation is a charitable 501(c)(3) organization funding childhood cancer research.
Stand Up To Cancer is a program of the Entertainment Industry Foundation, a 501(c)(3) charitable organization.

Photo by Nigel Parry

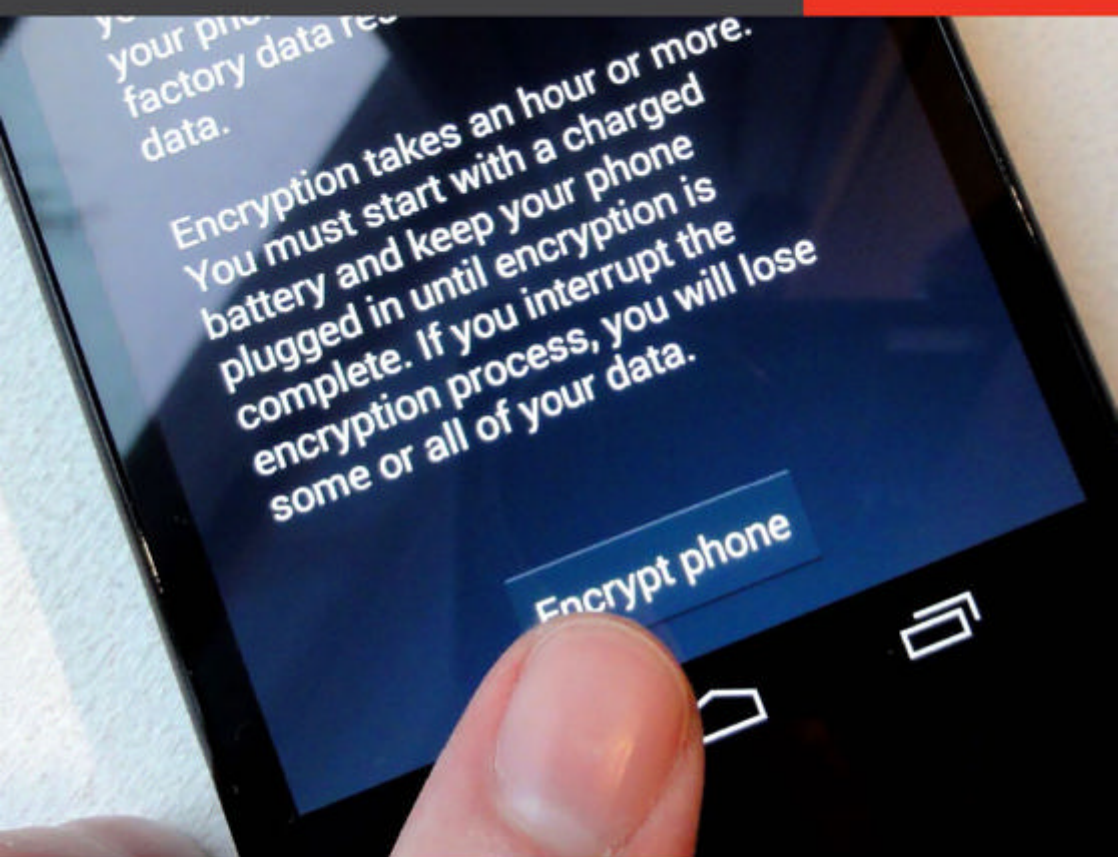
HERE'S HOW

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How to build, maintain,
and fix your tech gear.

**HERE'S
HOW**



9 ways to lock down your device before it goes missing

Don't wait until your phone or tablet goes missing to think about security.

BY BEN PATTERSON

YOU KNOW THAT icy stab of panic when you suddenly realize your Android phone or iPhone isn't safe in your pocket where it should be?

Sure, features like "Find my iPhone" on iOS or the Android Device Manager can help. But if bad guys have snatched your phone or tablet, they can do a lot of damage before you zero in on its location.

Read on for 9 easy ways to shore up your iOS or Android security, starting with a bonus tip.

Bonus: Lock your phone with a passcode, pronto

Here's a tip that's so obvious—well, to me, anyway—that I'm throwing it in as a bonus. Why mention it at all? Because I still run into far too many people who have never bothered to lock their phones or tablets with a PIN, even in an era of Touch IDs (for iOS) and traceable, easy-to-remember "pattern" locks (on the Android side).

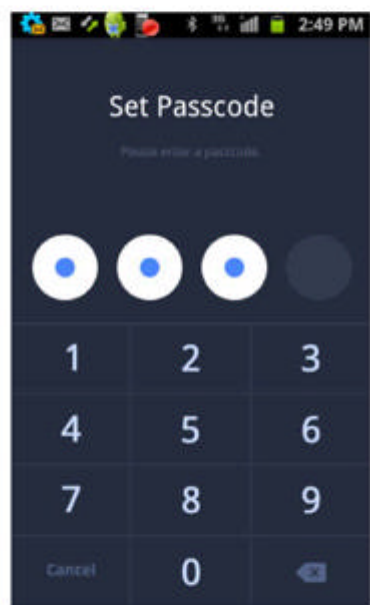
Now, if your tablet never leaves your coffee table, that's one thing. (Although... burglars!) But when it comes to your phone—and the emails, numbers, passwords, online banking apps, and other private data sitting in its memory—well, you're nuts if you don't have a lock-screen PIN.

So please, do yourself a favor and set a passcode if you haven't already. For iOS, tap *Settings > Passcode* (or *Touch ID & Passcode*, if your iPhone or iPad is Touch ID-ready).

For Android, tap *Settings > Security > Screen Lock*. And now, for the real tips...

1. Make sure Find my iPhone/iPad and Android Device Manager are up and running

Both Find My iPhone and Android Device Manager can pinpoint your missing devices, lock them remotely, set off their ringers, and even



Far too many people have never bothered to lock their devices with a PIN.

wipe all their data.

But neither of these apps will do you any good if they're not enabled before your gadgets disappear (and yes, they'll disappear, sooner or later). And believe me, you don't want your first time using Find my iPhone or Android Device Manager to be right after you've lost your phone or tablet.

For Android: Go to your browser of choice, make sure you're signed into Google with the same login as you used to set up your phone or tablet, then visit the Android Device Manager page.

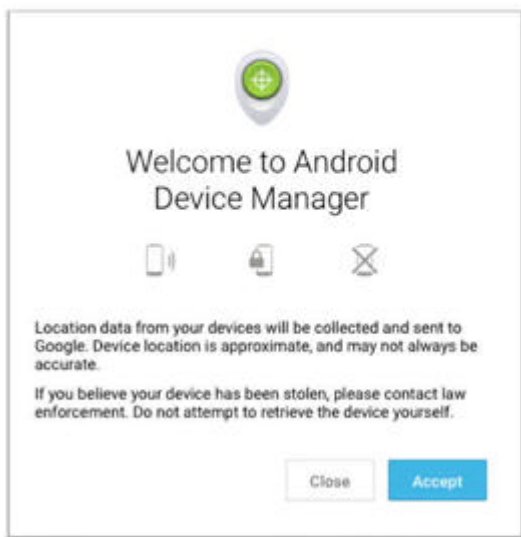
One of two things will happen: either your device's location will pop up onscreen, or you'll be prompted to send a notification to your phone or tablet. Tap the alert on your device to grant permission to Android Device Manager to track your handheld.

For iOS: Tap Settings, iCloud, Find My iPhone (or iPad), and make sure the Find My iPhone setting is enabled. Then sign into iCloud.com on a desktop web browser, click the Find My iPhone icon, and see for yourself whether your devices pop up on the map.

2. Set your device to require a passcode immediately (or almost immediately) after putting it to sleep

If you like, you can set your iPhone or Android phone to wake without a passcode after it's recently been unlocked—say, within a few hours or just a few minutes.

Convenient, yes, but wise? Hmm. For a tablet that usually sits at home, letting it wake without a passcode within an hour or so of being



Android Device Manager makes it easy to locate, ring, or wipe your device from the web.

unlocked is probably OK.

For the phone in your pocket, though, five minutes or less without needing a passcode is a smart move. Personally, though, I don't allow any of my iOS or Android phones to unlock without a passcode, ever.

Here's how to see—and perhaps strengthen—your own “wake without passcode” settings.

For Android: Tap *Settings* > *Security* > *Automatically lock*, then pick a setting anywhere from 30 minutes to immediately. Among the choices: 30 seconds or even just five seconds is a nice compromise between convenience and security.

For iOS: Tap *Settings* > *Passcode* > *Require Passcode*, then make your choice, from immediately to four hours. Note: if you're using Touch ID to unlock your iPhone or iPad, “Immediately” is the only “Require Passcode” setting that appears.



Control Center makes it easy to put your iPhone into airplane mode, rendering the Find My iPhone app useless.

3. Block access to Control Center (iOS)

Starting with iOS 7, both iPhones and iPads have shipped with Control Center, a handy slide-up window that gives you quick access to your device's Wi-Fi and cellular settings, media controls, alarms and timers, and the camera.

Because you can access it from the lock screen, Control Center makes it easy to put your iPhone into “Do Not Disturb” mode without entering a passcode, or switch on “Airplane mode” before your flight takes off. Unfortunately, Control Center also makes it easy for anyone to mess with your iPhone's or iPad's camera, alarm clock or wireless settings—even allowing, say, a thief to put your stolen iPhone into airplane mode, rendering the Find My iPhone app useless.

My recommendation: Block access to Control Center from your

iDevice's lock screen. No, you won't be able to flip on "Do Not Disturb" with a flick and a tap anymore, but better safe than sorry.

Tap *Settings* > *Control Center*, then switch off the *Access on Lock Screen* setting.

4. Use a stronger PIN, or a straight-up password

There's nothing stopping you from upping the security ante with a longer PIN, or even a full-on password.

On an Android phone, you can create numeric PINs or alphanumeric passwords up to 16 characters in length, more than enough to stump casual crooks (assuming, of course, you don't pick a password like "password123456789").

Meanwhile, I tried creating a 50-character password on my iPhone, and iOS didn't stop me.

Whether you really want a 50-character password is up to you, but the option is there for the taking.

For Android: Tap *Settings* > *Security* > *Screen lock*, tap either PIN or Password, then follow the steps.

For iOS: Tap *Settings* > *Passcode*, then disable the Simple Passcode option. Once that's done, you'll be prompted to create and verify a new passcode.

There's nothing stopping you from upping the security ante with a longer PIN or password.

5. Encrypt your data (Android)

Good news for recent buyers of new Android phones or tablets with Lollipop (the latest version of Android) pre-installed: The data on your device is already encrypted, rendering it well-nigh indecipherable until it's unlocked with your passcode.

Older Android phones and tablets, however—including those that have been updated to Lollipop—don't have encryption turned on by default. Switching it on is a simple matter of a few taps, but it could take anywhere from half an hour (in my case) to several hours before

all your data is fully encrypted, and you won't be able to use your phone or tablet during that time. You'll need to keep your phone plugged into its charger during the entire process.

Ready: Tap *Settings* > *Security* > *Encrypt phone*, then tap the final confirmation button.

Careful, though: Google warns that you could lose “some or all” of your data if you abort the encryption process midway through. And if you want to go back and turn off data encryption, you'll have to wipe your phone completely to do so.

6. Turn on Activation Lock (iOS)

Of course, plenty of phone thieves couldn't care less about your personal data. All they want to do is wipe and sell your precious handset.

A new iOS 8 feature called Activation Lock, however, will prevent anyone without the proper passcode from reactivating a lost iOS device, essentially turning it into an impeccably designed paperweight.

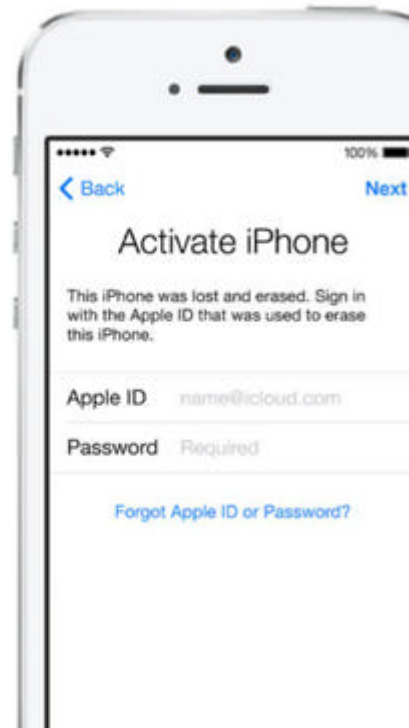
Pretty clever, but Activation Lock only works if you have “Find my iPhone” or “Find my iPad” enabled on your device. To make sure, follow these (hopefully familiar) steps: Tap *Settings* > *iCloud* > *Find my iPhone* (or *iPad*), then make sure Find my iPhone/iPad is switched on.

7. Put your name and contact info on the lock screen (Android)

If your phone or tablet somehow manages to go missing, you can always use the handy Android Device Manager to lock your device and flash a “rescue” message on the lock screen. With any luck, a good Samaritan will find your handset and get it back to you.

It's a smart idea, but what if your lost Android

Activation Lock
only works if you have “Find my iPhone” enabled on your device.



phone or tablet is in Airplane mode or otherwise out of wireless range? If that happens, sending a rescue message with your name and number won't do much good.

Instead, try this: Add a message to your device's lock screen now, before it gets lost—a message with your name, a phone number (not the number of your missing mobile, of course), an email address, or another reliable means of reaching you.

Just tap *Settings > Security > Owner info*, and enter the text of the message. On pre-Lollipop phones, you'll also need to check the box next to Show owner info on lock screen.

If you don't want just anyone combing through your notifications, you should hide them from your lock screen.

8. Set your iPhone/iPad to send a “ping” to Apple just before its battery dies (iOS)

Here's the last gasp for a missing iPhone or iPad that's run out of juice, leaving it unable to send a “ping” to Find My iPhone. Tap *Settings > iCloud > Find my iPhone (or iPad)*, then switch on the Send Last Location setting.

As the fine print below the setting points out, your handheld will send out a final ping—complete with location data—to Apple's servers, so at least you'll know where your iPhone or iPad was before it died.

9. Hide notifications from the lock screen (Android “Lollipop” and iOS)

Lock-screen notifications make for an easy way to check your e-mail, text messages, calendar events, and other mobile goings-on without having to unlock your iPhone or Android phone.

Unfortunately, they also make it easy for perfect strangers to read your messages and otherwise take a peek at your digital life.

If you don't want just anyone—and particularly smartphone

thieves—combing through your notifications, you might want to preemptively hide them from your lock screen.

For Android “Lollipop”: Tap *Settings* > *Sounds and notification*, then tap the *When device is locked* setting. From here, you can choose from three options: Show all notification content, Hide sensitive notification content (which, for example, still flashes alerts for new email but doesn’t display subject lines or contents), and Don’t show notifications at all.

For iOS: Unfortunately, hiding all notifications from the lock screen isn’t nearly as easy on iOS as it is for Android. Essentially, you’re going to have to check each app that offers notifications and see if lock-screen notifications are enabled—ugh. Tap *Settings* > *Notifications*, tap an app in the Include list, and make sure Show on Lock Screen isn’t switched on.

Lock down your iPhone’s or Android phone’s security settings before it up and disappears. That way, if the worst happens, at least you’ll have the grim satisfaction of knowing that whoever swiped your device will have little more than a paperweight on their hands. 🔒

10 Chrome extensions for streamlined productivity

BY DEREK WALTER

WHILE THERE ARE plenty of web-based tools and productivity tricks to help you power through tasks in your browser, you can step up and speed up your capabilities even more by grabbing some smart Chrome extensions.

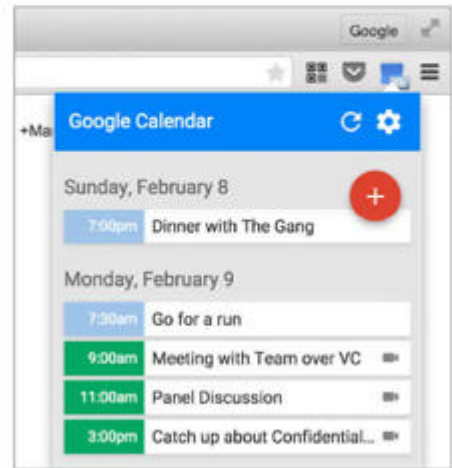
These add-ons add more functionality to Chrome for Windows and Chromebook users alike, enabling you to quickly save items to Google Drive, clip articles, or keep tabs on all your social media shares.



Google Calendar

The Google Calendar extension (go.pcworld.com/gcal) simplifies several tasks, eliminating the need to launch the calendar in another browser tab. It gives you quick access to creating a new event or checking out the upcoming schedule, so you don't miss that oh-so-riveting meeting.

The extension also lets you add any date listed on a webpage as a calendar entry. For example, if you see an event you want to attend, just highlight the text and right-click—you'll then get a popup to add it straight to your Google Calendar. It's a pretty slick feature, and makes this extension worth having around even if you're not an obsessive planner.



Google's Calendar extension keeps track of life's important events all in one place.

Save to Google Drive

Forget going through the pain of saving an image to your local hard drive and then separately uploading it to Google Drive. With the Save to Google Drive (go.pcworld.com/gdrive) Chrome extension, you can do it with one click.

You can even clip an entire webpage, saving it as a .png or html file—



Save web content or screen captures directly to Google Drive.

just right-click, and it'll be right there waiting for you in your Google Drive. You can also customize which Drive folder the images are saved in. Handy stuff indeed.

Snagit

The Snagit (go.pcworld.com/snagit) Chrome extension lets you grab a screenshot or narrate a short video, then quickly save it to your Google Drive. It handles screencasting very well, which is useful if you narrate a lot of walk-throughs or videos for co-workers or clients. Because it directly saves your clippings in Drive, there's no need to dig through your downloaded files to locate or share them. It's a powerful tool that is particularly Chromebook friendly.



Snagit lets you edit and share your screen captures.

Clearly

One of the most annoying aspects of today's web is all the clutter. Side columns, blinking ads, "Read this next!" suggestions—it's enough to make you go mad, especially when you're trying to focus on getting something done.



Clearly makes articles clean and easy to read.

Fight back with Evernote's Clearly (go.pcworld.com/clearly), which strips out all the peripheral content so you can just get to reading. While other extensions do the same, this one adds in the ability to mark up and highlight the

article for easy saving to Evernote.

Chrome is dabbling with its own native reader mode (go.pcworld.com/rm), but Clearly is a long-standing tool that is essential if you're an Evernote power user.

Todoist

Todoist is one of the best cross-platform task managers out there. The Todoist (go.pcworld.com/todoist) Chrome extension lets you add tasks, assign them to others, and check in on what you should be doing right now.

The extension works fine as a stand-alone to-do list at the free level, but a lot of its powers—like being able to categorize your tasks and assign them to others—come from the premium subscription. Nevertheless, Todoist's worth checking out. It's handy to have tasks right there in the browser toolbar that sync up with the Todoist iOS and Android apps.



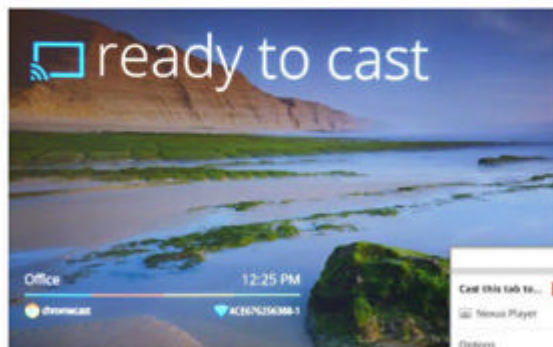
Todoist keeps you organized across all your devices.

Google Cast

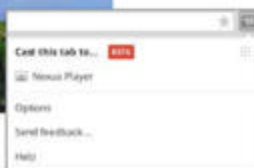
Google's Chromecast isn't just for entertainment. If you're presenting a slideshow or showing a video to a group of colleagues

or customers, it's the easiest way to cast your screen to another device.

So grab the



Find and play content on your Chromecast device from your Chrome browser.





The QR codes are very useful for opening links on mobile devices.

Google Cast (go.pcworld.com/gcast) extension, which quickly finds any connected Chromecasts on the same wireless network. You won't have to fiddle with wires when you need to dazzle your colleagues.

ShortenMe

Sharing links on social media is part of having an active Internet presence. ShortenMe (go.pcworld.com/shorten) quickly gives you a tweet-friendly link generated by Google's goo.gl service. It also keeps all kinds of cool stats on your links, so you can track how it

did when shared across Twitter, Facebook, or other social networks.

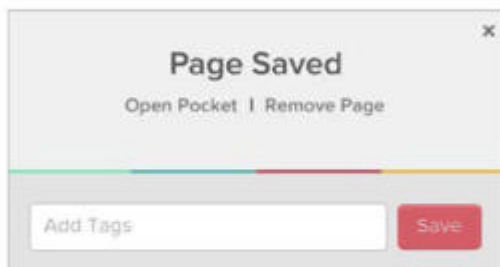
ShortenMe also transforms your link into a QR code. It's the perfect little tool that cuts down the steps needed to get your stuff out in the world.

Pocket

Pocket has grown beyond just being a read-it-later service (though it still excels at that).

It's now akin to a digital folder where you can save and share your research articles for work or school. Subscribing to Pocket's premium service (getpocket.com/premium) gives you additional search functions, organizational features, and a permanent archive for all of your clippings.

Even if you stick to the free level, Pocket's Chrome extension (go.pcworld.com/pocket)



Pocket automatically syncs to your phone, tablet or computer.

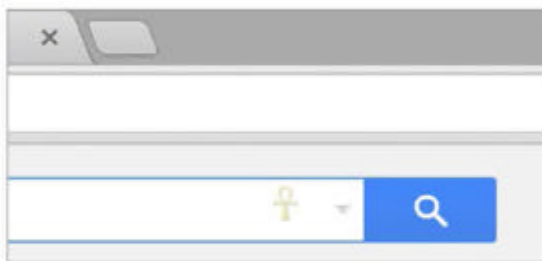
pcworld.com/chpocket) is worth having in your browser.

Lazarus: Form Recovery

Resurrect your forms from the digital beyond with Lazarus (go.pcworld.com/laz). This clever Chrome extension recalls the text you input into any online form or box in the event your browser crashes.

Chrome tends to be pretty stable, but it's always good to have a backup plan. And I've found Chrome's auto-fill feature can fill the boxes with info that isn't right for that context.

If your tab crashes, Lazarus will reload all the text that was on the page, which can be a huge time saver for filling out an application or online survey. You'll know it's working when the ancient Egyptian symbol appear on the screen.



Lazarus autosaves everything you type.



Pushbullet makes it easy to send pictures, files and links to your devices.

Pushbullet

Nothing ties your phone and desktop together quite like Pushbullet (go.pcworld.com/push).

With the Chrome extension you'll be able to get notifications directed at your phone right in your browser—as long as you download the companion iOS or Android app, of course.

There's also a neat feature that lets you copy text from the desktop and then paste it on your Android device. Pushbullet is always cranking out the new features, making it a must-have to help you leave your phone in your pocket while you're working. 🔌



Send Gmail attachments to Dropbox automatically

BY MICHAEL ANSALDO

ONE OF THE pitfalls of Gmail's generous storage limits is the temptation to use it as a warehouse for all your email attachments. That seems like less of a good idea when you have to wade through your inbox for that report you need for the weekly all-hands in 15 minutes. But processing the daily influx of messages from clients, colleagues, and friends takes long enough without having to stop and manually save each attached file you receive. Fortunately, you can create an automated workflow to do it for you.

We're going to use If This, Then That, or IFTTT, to create a system that automatically sends any new Gmail attachment to your Dropbox account, where it can be more easily organized and accessed. If you've never used IFTTT before, you may want to read our IFTTT primer first (go.pcworld.com/primer). Otherwise, let's get started.

Complete Trigger Fields step 3 of 7 back

Any new attachment in inbox

No fields to complete.

Create Trigger

Create an IFTTT
trigger to have
any new Gmail
attachment sent
to Dropbox.

Create a trigger

Login to IFTTT and click *Create a Recipe* from the dashboard. On the next page, the phrase “ifthishenthathat” appears with the word “this” highlighted. Click it, and you’ll arrive at a veritable app store of trigger channels. Scroll down to the Gmail icon, or use the search field to jump to it, and select it.

The page will automatically scroll down to a grid of various Gmail Triggers—sets of conditions that will instigate a desired response. We’re interested in email attachments here, so click on the “Any new attachment” box. Click *Create Trigger*. The phrase “ifthishenthathat” will appear again, only this time the word “that” is highlighted. Click it.

Define the action

You’ve created a trigger that will fire every time you receive an email with an attachment. Now it’s time to define what you want done with it. Select Dropbox from the list of available action channels, and then click the “Add file from URL” box from the grid of possible actions.

You’ll be presented with a list of “action fields”—File URL, File Name and Dropbox Folder Path—each of which has a drop-down menu of

You can create your own naming convention for your saved attachments using IFTTT “ingredients.”

“ingredients” you can add and arrange to define that action.

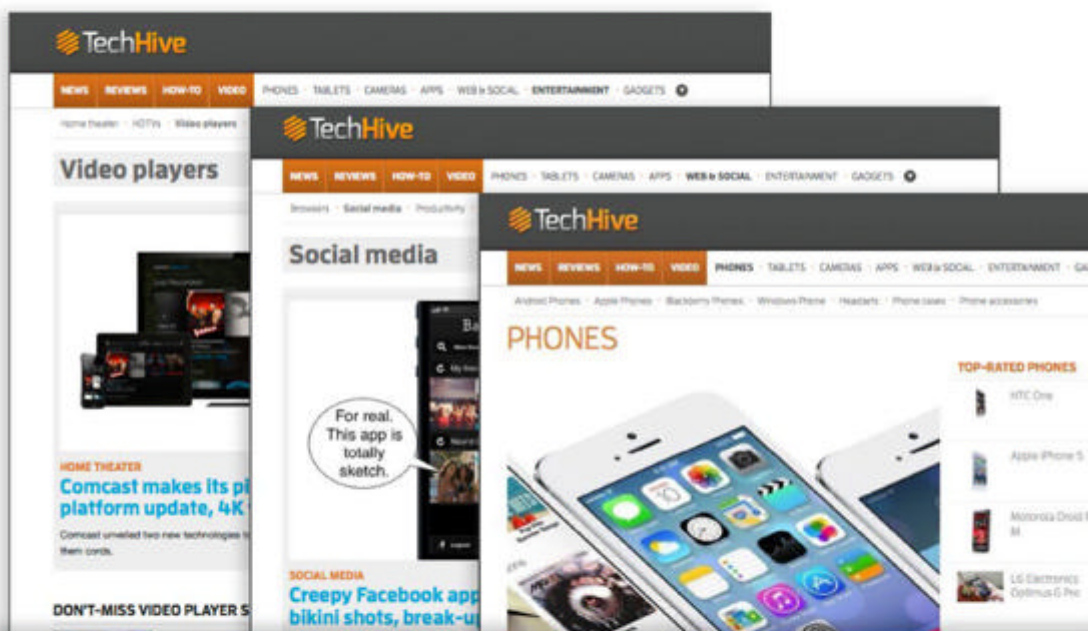
Because we’re separating attachments from their original emails, it’s critical to name them so they’re easily identifiable. Fortunately, IFTTT provides several options you can arrange into relevant naming schemes. To do this, click the beaker icon to the right of the File Name field and select as many ingredients as you want from the drop-down menu in the order you want them to appear in the file name. An ingredient list of `{{AttachmentFilename}} {{FromAddress}} {{Subject}}` makes a pretty effective naming convention, though you should, of course, use one that works for best you.

Similarly, click the beaker next to the Dropbox Folder Path field to define where your email attachments will be saved. The default path is “IFTTT/Gmail,” but you can enter your own or have one created automatically based on ingredients such as the sender, the date of receipt, or the email subject line.

Once you’ve defined these fields, click *Create Action*. Now all incoming email attachments will be automatically added to your Dropbox account. 🔌



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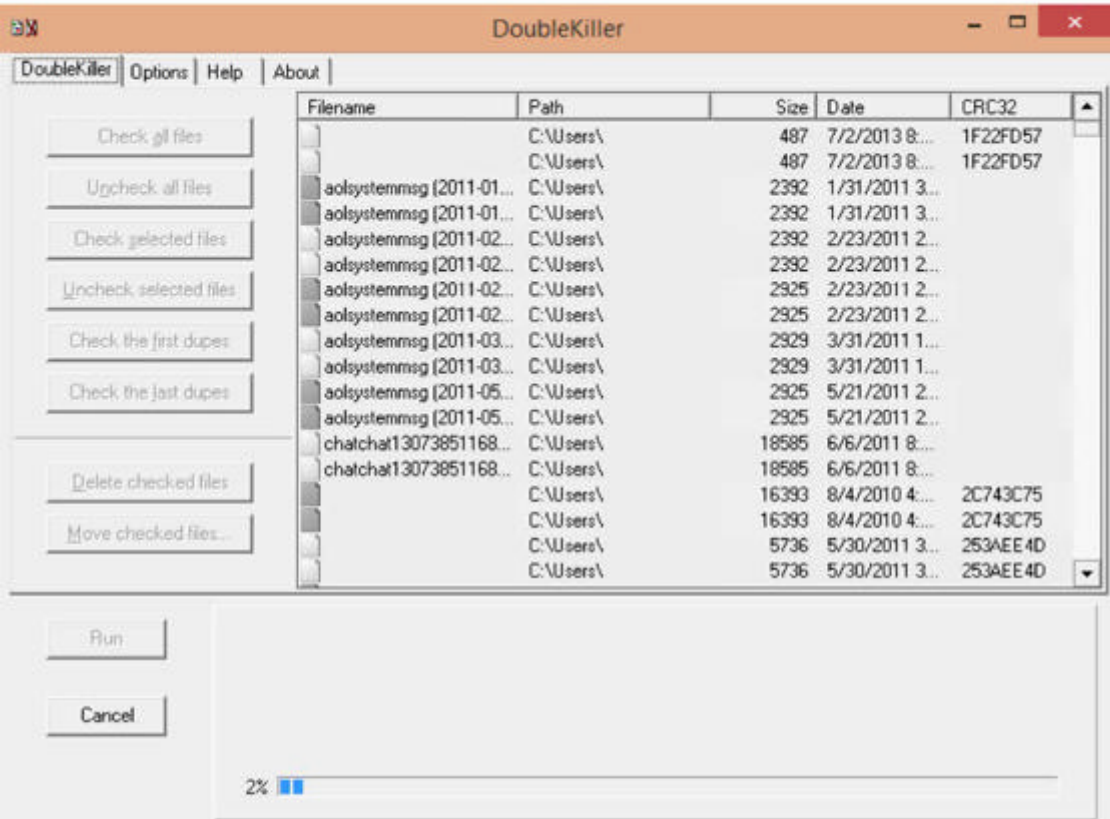


Find and eradicate duplicate files on your hard drive

ONE OF THE PAINS of owning a PC that's getting towards the end of its life is dealing with the ever-shrinking amount of storage as your PC fills up with music, photos, and documents. In the end, the only way to battle the bloat is often to get a new PC or more storage—but until you do, there are a number of tricks you can employ to make space on your PC.

A particularly handy one is to eliminate duplicate files and folders on your hard drive, getting rid of superfluous data you don't need. You'd be surprised how much content ends up duplicated on your PC thanks to a sync gone wrong with iTunes or an errant click with the photo importer.

Here are three tools that can help you reduce the clutter on your system.



DoubleKiller

1 DoubleKiller (go.pcworld.com/dk) is an all-purpose duplicate finder that can scan folders, your whole drive, and even other PCs on your local network. It compares file name, size, modification date, and even content (presumably by hashing a file's contents). The program also lets you exclude files by name, size, or type (XLS, MP4, etc.).

DoubleKiller has a lot of great features, but the interface may not be as straightforward as it could be. If you find yourself confused, start by adding some folders to scan under the Options tab then, go back to the DoubleKiller tab and click *Run*. Once it's done you can decide to delete your duplicates or move them to another location.

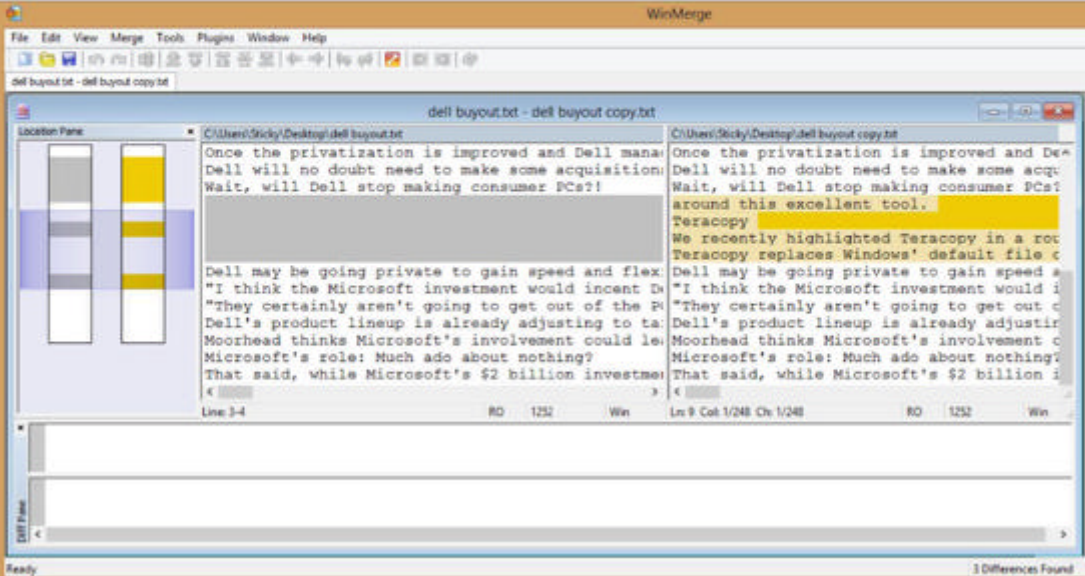
Filename	Folder	Size (KB)	Dimensions	Match %
113e2de01b8a781fa355ed461f26d9...	C:\User...	33	480 x 689	100
1329382895882.jpg	C:\User...	283	1920 x 2560	100
1329382895882.jpg	C:\User...	283	1920 x 2560	100
1385587995199.jpg	C:\User...	466	2448 x 3264	100
1385587995199.jpg	C:\User...	466	2448 x 3264	100
1386926910858.jpg	C:\User...	97	768 x 1024	100
1386926910858.jpg	C:\User...	97	768 x 1024	100
1387995502407.jpg	C:\User...	36	640 x 640	100
1387995502407.jpg	C:\User...	36	640 x 640	100
1387995519822.jpg	C:\User...	36	640 x 640	100
1387995519822.jpg	C:\User...	36	640 x 640	100
1387995585197.jpg	C:\User...	36	640 x 640	100
1387995585197.jpg	C:\User...	36	640 x 640	100
1387995631721.jpg	C:\User...	36	640 x 640	100
1387995631721.jpg	C:\User...	36	640 x 640	100
1387996491540.jpg	C:\User...	37	640 x 640	100
1387996491540.jpg	C:\User...	37	640 x 640	100
1388733890189.jpg	C:\User...	1655	2448 x 3264	100
1388733890189.jpg	C:\User...	1655	2448 x 3264	100
1389373522066.jpg	C:\User...	37	640 x 640	100
1389373522066.jpg	C:\User...	37	640 x 640	100
1389373569858.jpg	C:\User...	37	640 x 640	100
1389373569858.jpg	C:\User...	37	640 x 640	100
DSC03182.JPG	C:\User...	455	2304 x 1296	100

0 / 692 (0.00 B / 1.20 GB) duplicates marked.

dupeGuru Picture Edition

2 As its name suggests, dupeGuru Picture Edition (go.pcworld.com/dg) is all about finding doubles in your image folders. Pictures can be one of the top sources of duplicates for many people, especially as we migrate to new PCs, restore data from backups, and keep pictures in different cloud services like Dropbox, Google+, and OneDrive.

DupeGuru PE is very easy to use. All you get is a simple window with options to add folders for scanning. When you're ready, just hit Scan and let the program do its magic, then decide what to keep once it's done.




Winmerge

3 This is a seriously useful tool if you have a lot of documents or text files kicking around and need to pare them down. Winmerge (go.pcworld.com/wm) lets you compare two versions of a document (or an entire directory) and then view the actual differences between them on screen. You can then choose to merge the text into one preferred document.

Unlike the other tools, Winmerge isn't about searching your hard drive for duplicate files. Instead, you have to know that the two files or directories you're comparing are similar or earlier versions of each other.

The big advantage is that you can see the differences and then easily bring your files together into one canonical version. At first glance, you may find Winmerge's interface a little overwhelming, but don't be intimidated. The icons are designed to offer visual cues to help you understand how everything works.

With these three tools you'll end up with a little more space on your hard drive in no time. 



Connect your laptop to your HDTV without HDMI

Ramanathan wants to stream video from his laptop to his HDTV. But his laptop doesn't have an HDMI port.

You can have an Internet-ready smart TV with a Roku plugged into it, and at some point you'll want to watch something that neither of them support. (For me, it's password-protected Vimeo streams.) That's when you need to plug your laptop directly into your HDTV.

If your laptop lacks an HDMI port, connecting it to a TV isn't so easy. But it isn't incredibly difficult either. It's all a matter of figuring out

which ports you do have and which adapters you need.

If you have a very small laptop, you may have an HDMI port and not know it. Look for a micro HDMI port: It's about the same size as a micro USB port. You can buy an adapter or a cable that will let you connect it to the standard HDMI port on your TV.

If you don't have Micro HDMI, see if your laptop has a DisplayPort, which can handle the same digital video and audio signals as HDMI. You can buy a DisplayPort/HDMI adapter or cable cheaply and easily. (This is how I watch those password-protected Vimeo streams.)

Don't have either of those? Maybe your laptop has a DVI port. You can't miss it; it's the silliest-looking port ever designed. And once again, adapters and cables are readily available to connect this port to your HDTV.

But there's a problem: DVI is a video-only format. It doesn't carry audio. So you have to find another way to get the sound out. Your television might have an analog audio input associated with one of the HDMI ports. If it does, you can use a 3.5mm male-to-male audio cable to connect your laptop's sound system to your TV's speakers. If it doesn't, you'll have to use other speakers. If you have a separate receiver in the room, connect the laptop's audio to that. Otherwise, consider buying some computer speakers.

If your laptop doesn't have any of these ports, it will almost certainly have good old VGA. The same goes for your HDTV. Check your TV's manual to see what resolution the laptop should be set to. And don't expect the same image quality you'd get with HDMI, DisplayPort, or DVI.

VGA, like DVI, is video-only. The solutions I suggested above should work here, as well. And you're far more likely to have an audio input associated with the VGA port. 🗣️



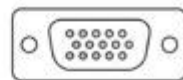
**Micro HDMI to
HDMI cable**



Display Port



DVI port



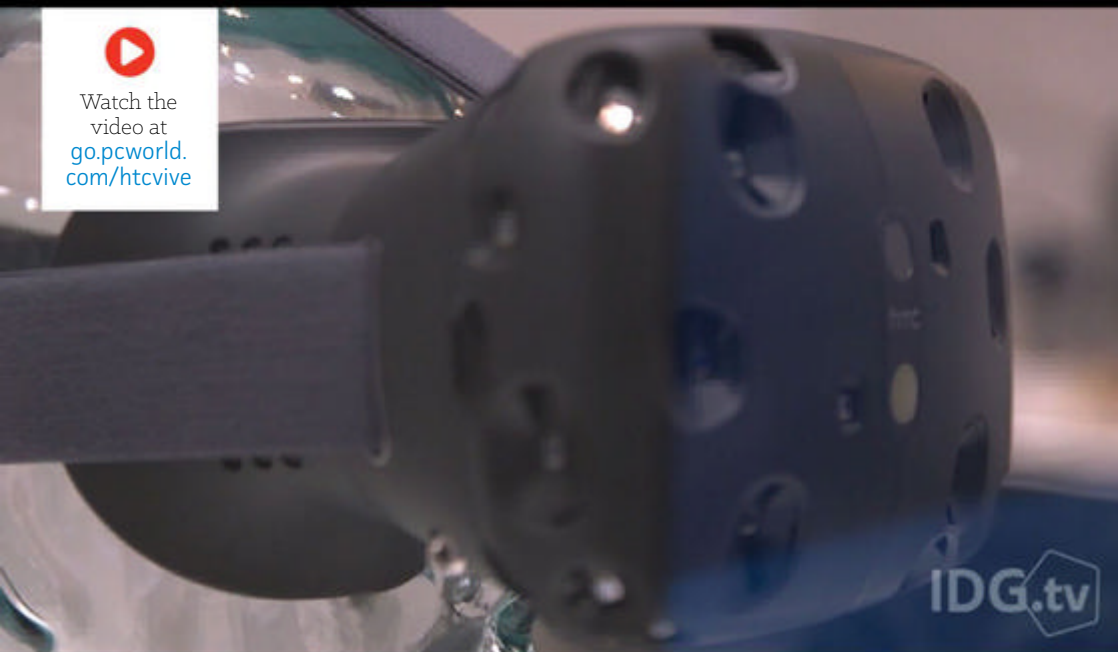
VGA port

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